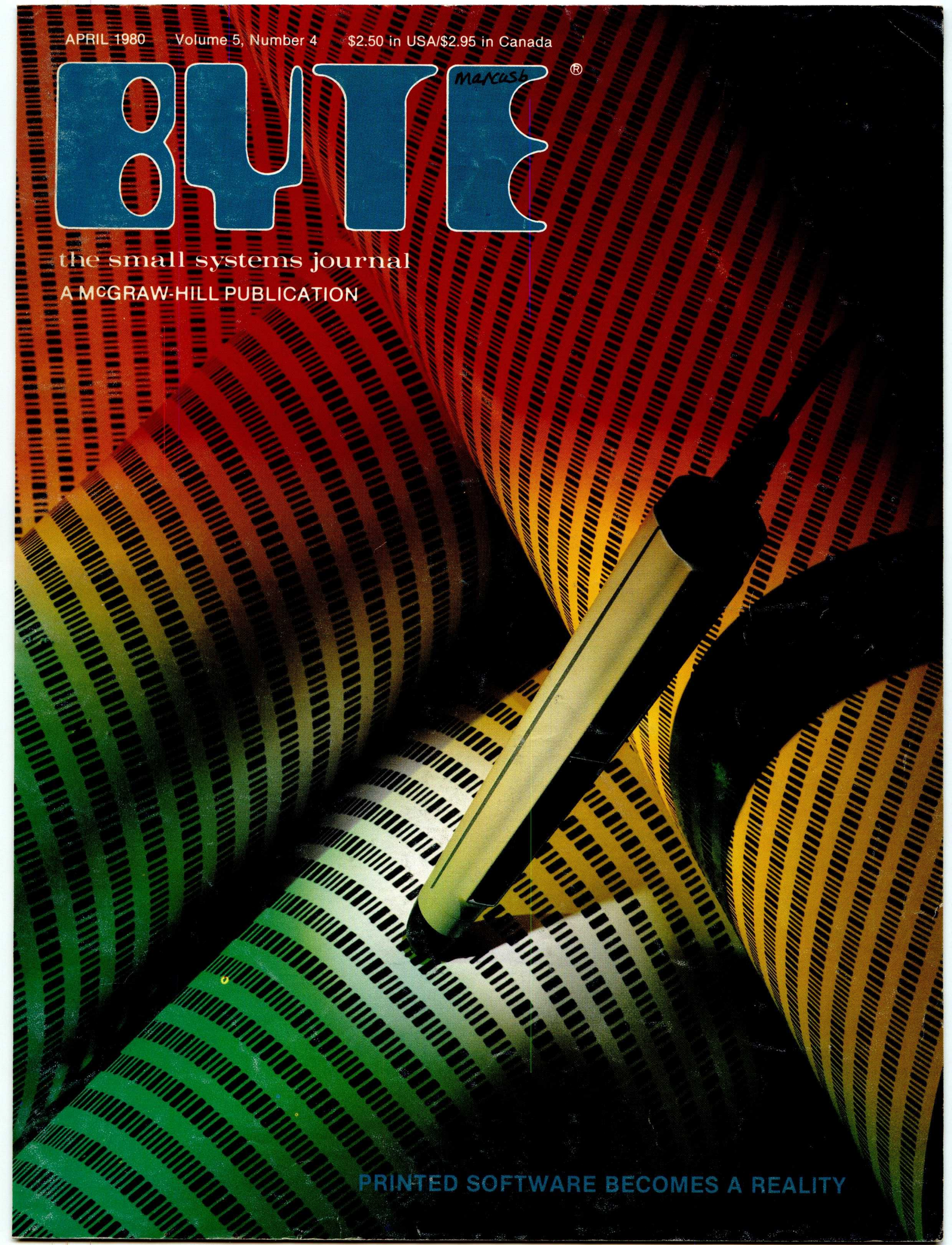

APRIL 1980
Volume 5, Number 4
$2.50 in USA/$2.95 in Canada
BYTE ®
Marcus
the small systems journal
A McGRAW-HILL PUBLICATION
PRINTED SOFTWARE BECOMES A REALITY

UNIVERSAL static memory card

★ 32K bytes-ROM, RAM, EPROM or a combination

★ SS-50 A&C compatible with 16 and 20 bit address decoding

★ Compatible with all SWTPC 6800 and 6809 computers

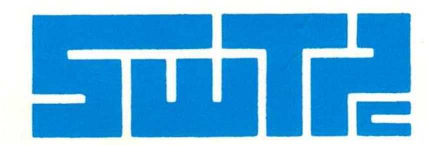
This is the most versatile memory card you can buy. Our S-32 may be populated with up to 32K of static RAM, EPROM, or ROM, or any 4K block combination of these that you may desire. Any 5-volt 2716 pinout compatible memory may be used in this card. Any 4K block of the memory may be jumper block programmed for RAM or ROM use. This feature makes this the ideal memory for those process control applications that require a mixture of ROM and RAM memory. The board is fully compatible with all SWTPC 6800 and 6809 computers.

The power requirement for the board is only 1.75 amps at 5.0 volts with a full 32K of RAM installed.

S-32 Circuit card assembled
—less memory IC's (uses up to 16) .$99.50

2716 Type EPROM for above . . . . . . $50.00 ea.

16K (2K x 8) Static RAM for above
(4016 or 2128). . . . . $50.00 ea.



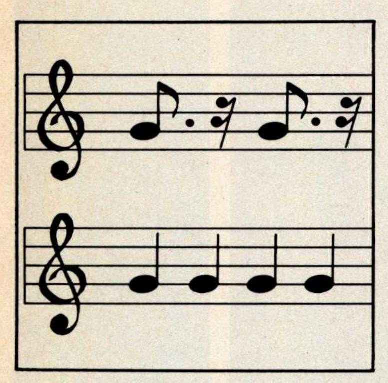
SOUTHWEST TECHNICAL PRODUCTS CORPORATION
219 W. RHAPSODY
SAN ANTONIO, TEXAS 78216 (512) 344-0241

Circle 258 on inquiry card.

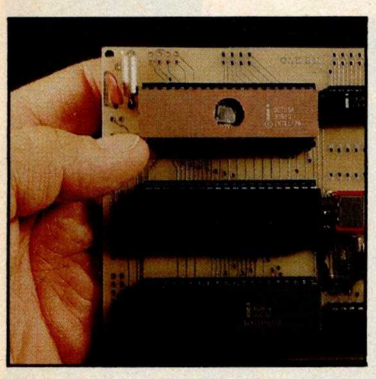
McGraw-Hill

In The Queue

BYTE April 1980
Volume 5, Number 4



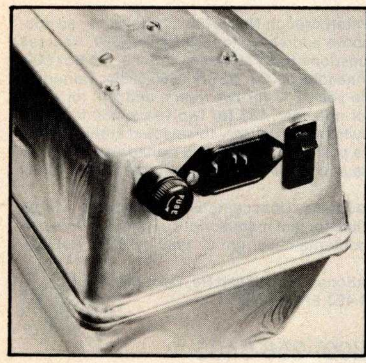
page 18



page 40



page 60



page 234

Foreground

Background

Nucleus

Publishers
Virginia Londoner, Gordon R Williamson
Associate Publisher
John E Hayes
Assistant
Cheryl A Hurd

Editorial Director
Carl T Helmers Jr
Editor-in-Chief
Christopher P Morgan
Book Editor
Bruce A Roberts
Editors
Richard S Shuford, Gregg Williams, Curtis P Feigel
Assistant to the Editors
Faith Ferry
Assistant
Debe Wheeler
New Products Editor
Clubs, Newsletters
Charles Freiberg
Drafting
Jon Swanson

Production Director
Nancy Estle
Production Art
Wai Chiu Li, Christine Dixon, Holly Carmen LaBossiere, Deborah Porter

Senior Copy Editor
David William Hayward
Copy Editors
Faith Hanson, Warren Williamson, Robin M Moss, Anthony J Lockwood

Typographers
Sherry McCarthy, Deborah Fredericks

Advertising Director
Thomas Harvey
Assistants
Ruth M Walsh, Ms. Marion Gagnon
Special Projects Coordinator
Jill E Callihan
Assistant
Karen A Cilley
Marketing Coordinator
Laura A Hanson

Circulation Manager
Gregory Spitzfaden
Assistants
Pamela R H Spitzfaden, Agnes E Perry, Melanie Bertoni, Barbara Varnum, Louise Menegus
Dealer Sales
Thomas Yanni
Receptionist
Jacqueline Earnshaw

Traffic Department
Mark Sandagata

Controller
Daniel Rodrigues
Assistant
Mary E Fluhr
Accounts Receivable Specialist
Karen Burgess
Accounts Receivable Assistant
Jeanne Cilley

National Advertising Sales Representatives:
Hajar Associates Inc
East
280 Hillside Av, Needham Heights MA 02194
(617) 444-3946
521 Fifth Av, New York NY 10017
(212) 682-5844
Midwest
664 N Michigan Av, Suite 1010, Chicago IL 60611 (312) 337-8008
West, Southwest
1000 Elwell Ct, Suite 227, Palo Alto CA 94303
(415) 964-0706/(714) 540-3554



ON THE COVER

This month's cover features Hewlett-Packard's new bar code loader. The unit is described in detail in Carl Helmers' editorial on page 6. Bar codes, have been around for several years, in one form or another, but the HEDS-3000 Digital Wand is the first serious attempt to make bar codes a part of personal computing. Bar code readers will soon be used to enter recipe information into your microwave oven, read the bar codes on groceries, and enter programs into your computer.

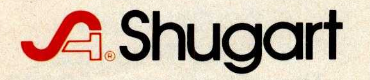
Also in this issue are several articles dealing with computer music. A lot has happened since our last special issue on music in September, 1977. Many of the new computers feature sound effects as a matter of course, such as the Atari and Texas Instruments models. This month Hal Chamberlin talks about recent developments in digital-to-analog (D/A) techniques for multiple-voice music generation; Jef Raskin describes a musical "amanuensis" or computerized music stenographer (the first of two parts); and Randolph Nelson reveals the details of how to enter and modify musical information into a computer quickly and efficiently.

Officers of McGraw-Hill Publications Company: Paul F. McPherson, President; Executive Vice Presidents: James E. Boddorf, Gene W. Simpson; Group Vice President: Daniel A. McMillan; Senior Vice President-Editorial: Ralph R. Schulz; Vice Presidents: Kemp Anderson, Business Systems Development; Stephen C. Croft, Manufacturing; Robert B. Doll, Circulation; James E. Hackett, Controller; William H. Hammond, Communications; Eric B. Herr, Planning and Development; John W. Patten, Sales; Edward E. Schirmer, International.
Officers of the Corporation: Harold W McGraw Jr, President, Chief Executive Officer and Chairman of the Board; Robert F Landes, Senior Vice President and Secretary; Ralph J Webb, Treasurer.

BYTE is published monthly by BYTE Publications Inc, 70 Main St, Peterborough NH 03458, a wholly-owned subsidiary of McGraw-Hill, Inc. Address all mail except subscriptions to above address: phone (603) 924-9281. Address subscriptions, change of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, PO Box 590, Martinsville NJ 08836. Controlled circulation pending, Waseca, Minnesota 56093. (ISSN 0360-5280). Canadian second class registration number 9321. Subscriptions are $18 for one year, $32 for two years, and $46 for three years in the USA and its possessions. In Canada and Mexico, $20 for one year, $36 for two years, $52 for three years. $32 for one year air delivery to Europe. $32 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $2.50 in the USA and its possessions, $2.95 in Canada and Mexico, $4.00 in Europe, and $4.50 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in United States of America.
Address all editorial correspondence to the editor at the above address. Unacceptable manuscripts will be returned if accompanied by sufficient first class postage. Not responsible for lost manuscripts or photos. Opinions expressed by the authors are not necessarily those of BYTE.
BYTE® is available in microform from University Microfilms International, 300 N Zeeb Rd, Dept PR, Ann Arbor MI 48106 USA or 18 Bedford Row, Dept PR, London WC1R 4EJ ENGLAND.

AUDITED PAID CIRCULATION ABC

Subscription WATS Line: (800) 258-5485
Office hours: Mon-Thur 8:30 AM - 4:30 PM, Friday 8:30 AM - Noon, Eastern Time



Editorial

Bar Codes, Revisited . . .

Carl Helmers

It was with great excitement that I opened a package which recently arrived from Hewlett-Packard's Optoelectronics people in Palo Alto, California. This package contained one of the first production versions of the model HEDS-3000 bar-code data-entry wand. A photo of the wand as it came to us was prepared by Ed Crabtree as a cover for this April 1980 issue of BYTE. The bar-code reader opens the way to a whole new field of applications of small intelligent processors.

As long-time readers of BYTE will recall, we have in the past presented no small amount of information on the concept of printing digital information in bar-coded form as a method of economically distributing data or programs for use in a personal computer or other local processors. (See page 10 for "A History of Bar Code Information Published in BYTE.") The idea is to treat the printed medium as a means of distributing data. With five centuries or so of technological progress since Johann Gutenberg's day, the techniques of making a good image on paper have been fairly well debugged.

In the winter of 1976, I had first thought about this subject, then filed it away as an impractical scheme. My first thinking had been to try and use the direct output of a typewriter to record binary 1s and 0s. But 1s and 0s are not the ideal printed images to decode. They vary from typewriter to typewriter and have fairly low tolerance for variation in the position of a simple photosensor's scan. After putting aside this idea at that time, I expected to go no further with it.

But then in the summer of 1976 I was approached by Walter Banks, who, at the time, was associated with the University of Waterloo's Computer Communications Network Group. Walter proposed to transform the printing scheme into a true bar code, rather than to use my original idea of employing a type font. He commented that the University of Waterloo had an old Photon phototypesetter that communicated directly to several of his computers, so that it would be a relatively trivial task to create bar-code images for various data sets. This gave us a representation which was realizable.

But there was the problem of scanners. The technique would never become practical until a scanner that could be marketed for our target price, $50 in 1976 dollars. (Four years later, at an order of magnitude of 10% per annum inflation, our 1980 target is about $73.) The arbitrary figure of $50 (1976) was chosen so that the incremental cost would be small compared to the cost of a system which might use the technique. During the course of 1977, 1978, and 1979, we have from time to time printed texts containing data encoded in a bar-code format in order to experiment with the technique, even if no scanners were available which met the price criterion. The thought here was that among our readers would be individuals who might wish to experiment with methods of reading the form.

We also published a book written by Ken Budnick, about loaders and algorithms for decoding bar codes with several popular microprocessors. (This book, entitled *Bar Code Loader*, is available at a price of $2 plus postage of $0.60. It may be ordered from BYTE Books, 70 Main St, Peterborough NH 03458.)

But there remained the key requirement of an inexpensive mass-produced sensor for the bars. It would do little good to have a neat method of entry for mass-produced data unless the entry method were at a mass-produced price level (ie: not expensive relative to the total cost of the computer system). At the time Walter suggested this idea to me in the summer of 1976, the typical price of a commercially available bar-code sensor wand was $300 and up. We needed to excite enough interest in the concept to get a manufacturer interested in the technique for a number of purposes.

As a result of the interest expressed in the magazine, Walter and I were contacted by John Sien of Hewlett-Packard's Optoelectronics Division in the spring of 1978. That year we stopped by at Hewlett-Packard after the National Computer Conference, which was held in Anaheim, California, as it will be again in May of this year.

Walter and I spent a solid day of activity with John and several of his product engineering and development people going over the functional specifications of what we wanted to see in a bar-code reader that was to be suitable for use with printed software. We were, of course, not told about specific details of any product they might have had under development at that time. Our purpose was to convey the functional specifications and an idea about the potential markets for such a product in the personal-computing area. But, as recent events have confirmed, Hewlett-Packard has decided to market just such a product.

The product is the Model HEDS-3000 bar-code reader wand, which is found on this month's cover. The wand can be purchased off the shelf from any Hewlett-Packard distributor around the world. The list price for a single unit is $99.50 from the distributor. Technical information about the digital wand can be obtained by contacting Hewlett-Packard directly at 640 Page Mill Rd, Palo Alto CA 94304; Attention: John Sien. The technical information that comes with the prototype reader kit includes the *Digital Wand User's Manual* for the HEDS-3000 and the detailed six-page engineering specifications for the device, dated October 1979 in the case of our copy.

The wand's price in production quantities will of course be significantly lower than the single-unit price of $99.50, depending on volume and details of the transaction like custom molding. John reports that Hewlett-Packard will supply this product in volume with numerous optional specifications. For example, there are 193 different combinations of case colors. The wand can be had in quantity with or without the manual push-to-read switch, with or without a custom label, and with or without the nine-pin D-type connector found in the prototype version.

John also reports that there is considerable interest from appliance manufacturers in use of this product to enter user-variable data. Thus, we can, for example, foresee microwave ovens that have scanning wands for entry of cooking instructions, kitchen computers that use scanning wands for entry of nutritional data used in managing various kinds of special diets, and other such appliances. To such a manufacturer of appliances, the bar-code option is very real and usable now, because of the existence of this product.

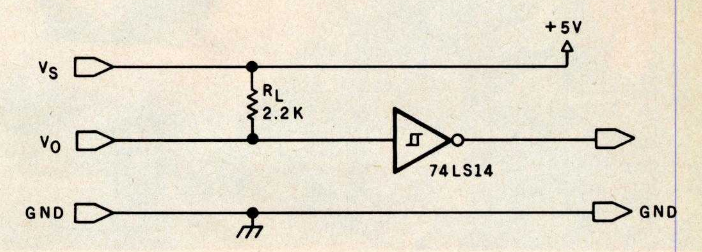
Other applications suggested by some of the Hewlett-Packard literature on the wand include file-folder tracking in offices, ticket verification, identifying assemblies in an electronics-service environment, security checkpoint verification, and the "classical" application of inventory control. This bar-code wand is the same one which is used to distribute user-library programs in an attachment for the HP-41C calculator, although it has a special interface and a different model number in that application.

For experimenters and systems designers interested in trying the wand, its interface is a model of simplicity and ease. Three wires are all that are required, as seen in figure 1. This figure is reproduced from page 9 of the excellent fifteen-page user's manual which accompanies the prototype kit for the HEDS-3000.

One wire supplies power, which is specified to be from 3.6 to 5.75 V. The reader attachment consumes a nominal, but fairly trivial, 50 mA worst-case current. A second wire is ground. The third wire is a signal connection, which represents an open-collector output similar to that of a typical opto-isolator. In the transistor-transistor logic (TTL) interface of figure 1a, this signal line is pulled up to the supply voltage with a 2.2 K ohm resistor. The recommended TTL-level interface also obtains hysteresis by using a Schmitt trigger integrated circuit, such as the 74LS13. Figure 1b shows a somewhat more complicated complementary metal-oxide semiconductor (CMOS) logic interface.

As of this writing, I have not yet connected the wand and experimented with it. Nearly any computer will do for those who wish to try this circuit. An obvious connection, for example, is to the game-paddle port of an Apple II computer, which has the necessary power and signal lines. A similar arrangement could be made with a parallel data port for the typical S-100-based computer such as the North Star or Cromemco machines. For complete low-level, assembly-language software needed to read bar codes published as a PAPERBYTE® , see Ken Budnick's book mentioned earlier. In it readers will find 8080/Z80, 6502, and 6800 versions of routines needed to scan our PAPERBYTE® format. These routines may also be used as a model for similar programming of other formats such as the HP-41C calculator format.

How about printing bar-code formats? It turns out that our original use of a phototypesetter is far more elaborate than is really required. Any software house can begin to supply variations of their products in bar-coded form



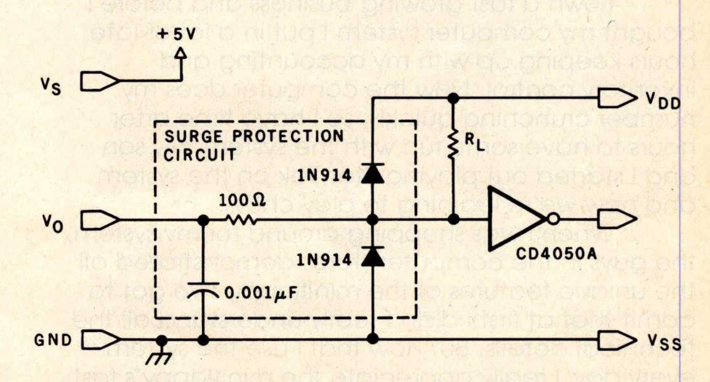


Figure 1: *A pair of schematics showing (1a) the TTL interface for the HEDS-3000 bar-code reader, and (1b) the CMOS-logic interface. This diagram is reproduced from page 9 of the HEDS-3000* Digital Wand User's Manual, *which accompanies the reader in a prototyping kit.*

At Intersystems, "dump" is an instruction. Not a way of life.

(Or, when you're ready for IEEE S-100, will your computer be ready for you?)



We're about to be gadflies again.

While everyone's been busy trying to convince you that large buses housed in strong metal boxes will guarantee versatility and ward off obsolescence, we've been busy with something better. Solving the *real* problem with the first line of computer products *built from the ground up to conform to the new IEEE S-100 Bus Standard*. Offering you extra versatility in 8-bit applications today. And a full 16 bits tomorrow.

We call our new line Series II.™ And even if you don't need the full 24-bit address for up to 16 megabytes (!) of memory right now, they're something to think about. Because of all the performance, flexibility and economy they offer. Whether you're looking at a new mainframe, expanding your present one or upgrading your system with an eye to the future. (Series II boards are compatible with most existing S-100 systems and *all* IEEE S-100 Standard cards as other manufacturers get around to building them.)

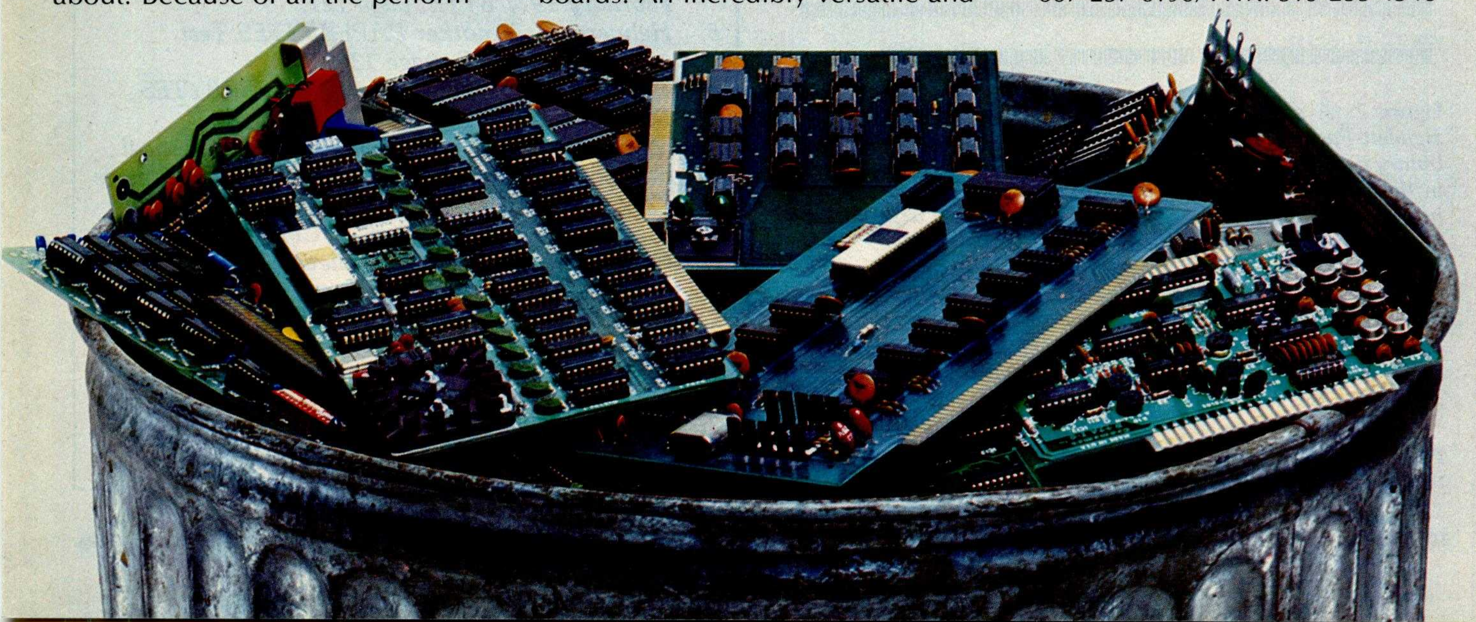
Consider some of the features: Reliable operation to 4MHz and beyond. Full compatibility with 8- and 16-bit CPUs, peripherals and other devices. *Eight* levels of prioritized interrupts. Up to 16 individually-addressable DMA devices, with IEEE Standard overlapped operation. User-selectable functions addressed by DIP-switch or jumpers, eliminating soldering. And that's just for openers.

The best part is that all this heady stuff is available *now*! In our advanced processor—a full IEEE Bus Master featuring Memory Map™ addressing to a full megabyte. Our fast, flexible 16K Static RAM and 64K Dynamic RAM boards. An incredibly versatile and economical 2-serial, 4-parallel Multiple I/O board. 8-bit A/D-D/A converter. Our Double-Density High-Speed Disk Controller. And what is undoubtedly the most flexible front panel in the business. Everything you need for a complete IEEE S-100 system. Available separately, or all together in our new DPS-1 Mainframe!

Whatever your needs, why dump your money into obsolete products labelled "IEEE timing compatible" or other words people use to make up for a lack of product. See the future now, at your Intersystems dealer or call/write for our new catalog. We'll tell you all about Series II and the new IEEE S-100 Bus we helped pioneer. Because it doesn't make sense to buy yesterday's products when tomorrow's are already here.

InterSystems™

Ithaca Intersystems Inc.,
1650 Hanshaw Road/P.O. Box 91,
Ithaca, NY 14850
607-257-0190/TWX: 510 255 4346



using a relatively inexpensive piece of equipment added to a typical small-computer system, namely a high-resolution, hard-copy printer with relatively small incremental-spacing intervals.

For example, Tom McNeal of Hewlett-Packard's Corvallis Division (manufacturers of the HP-41C calculator) reports that he uses an impact printer with carbon-film ribbon to produce bar codes in the format shown in figure 2. Printers with similar characteristics of high-resolution placement of vertical bar characters are manufactured by companies such as Diablo, Qume, and NEC. In preparing an output of digital information, the precise spacing of the vertical bar characters is used to create a wide- or narrow-width imprint depending on the details of the format used.

Let us conclude this commentary with some critique on the potential uses of the bar-code format in publishing programs or data. The first and most important comment is that the technique is not intended to be useful with large files of data. When the bulk of information to be transferred by a user is in excess of ten to twenty thousand bytes, the bar-code method is not at all appropriate. It is best used for chunks of data that are on the order of hundreds of bytes rather than tens of thousands.

The reason for this comment is that in our previous experiments with homebrew prototype wands, we found that the practical data-rate-equivalent for the manually guided input of data is about 10 characters per second. The benchmark was taken using input from bar-coded program texts published in BYTE's various PAPERBYTE® software books. This data rate compares favorably with the paper-tape reader on an ASR33 Teletype, but is not at all desirable for repeatedly loading a 10,000-byte file.

But, when the data to be loaded has a high semantic content per byte of coded information, bar codes are quite appropriate. This is especially true when the system in which the bar code is used must deal with a great variety of such detailed specifications. An example of such semantically dense coding is the typical electronic calculator program, which might have several hundred bytes of information representing a very high level of function in each byte. Another example might be evidenced by instructions for some hypothetical kitchen cooking appliance, which are printed as perhaps a hundred bytes of data on a food package. Another classic example often used in the past is use of bar codes as an inventory-control technique in fields as diverse as libraries and factories. And of course, the Universal Product Code (UPC) information found on many standardized supermarket products can be read by this wand, thus allowing home and kitchen applications impossible for personal computers before this price breakthrough.

So, I will close my present commentary about bar codes by noting that we can expect further lively applications articles to appear in future issues of BYTE. This is a natural prediction based on the fact that readers now can get their hands on the necessary hardware at a very reasonable price. The clever designers and marketeers of Hewlett-Packard have made the bar-code technology quite practical and useful in numerous new applications of the small computer. ■

```
ROOT FINDER

PROGRAM REGISTERS NEEDED:  21

ROW 1 (1 - 2)

ROW 2 (2 - 5)

ROW 3 (6 - 8)

ROW 4 (9 - 13)

ROW 5 (14 - 24)

ROW 6 (25 - 36)

ROW 7 (37 - 45)

ROW 8 (45 - 55)

ROW 9 (56 - 65)

ROW 10 (66 - 71)

ROW 11 (71 - 75)
```

Figure 2: *A sample of bar codes in the format used by the Hewlett-Packard HP-41C calculator. This sample consists of binary code for the HP-41C program called Root Finder, found in the HP-41C Standard Pac library. This image was prepared by Tom McNeal, who is a development engineer with the Corvallis Division of Hewlett-Packard.*

The format specifies that 2 start bits (both binary 0) be used, followed by three 8-bit header words, up to 13 data bytes, and then 2 stop bits (the first set to binary 1, the second to 0). The wide bars, which represent binary 1s, should be twice the width of the narrow bars, which represent binary 0s. The spaces serve as a gauge for the width of the narrow bars.

The original image was printed on an 8½ by 11 inch sheet of paper, but in reproducing it for use in the magazine we have reduced it in size to fit our layout.

A History of Bar-Code Information Published in BYTE

1. *Banks, W, C Helmers, and R Sanderson, "A Proposed Standard for Publishing Binary Data in Machine Readable Form," November 1976 BYTE, page 10.*
2. *Banks, W, "Samples of Machine Readable Printed Software," December 1976 BYTE, page 12.*
3. *Farnell, C, and Seeds, G, "A Novel Bar Code Reader," October 1978 BYTE, page 162.*
4. *Helmers, C, "Further Notes on Bar Codes," February 1977 BYTE, page 121.*
5. *Helmers, C, "Another PAPERBYTES Test," March 1977 BYTE, page 130.*
6. *Helmers, C, and S S Loomis, "PAPERBYTES Forum," July 1977 BYTE, page 128.*
7. *Merkowitz, F L, "Signal Processing for Optical Bar Code Scanning," December 1976 BYTE, page 77.*
8. *Merkowitz, F L, "Micro-Scan Corporation Bar Code Scanner" (Product Review), October 1978 BYTE, page 166.*
9. *Regli, K, "Software for Reading Bar Codes," December 1976 BYTE, page 18.*
10. *Shuford R, "A Proposal for a Kitchen Inventory System, or Don't Byte the Wand That Feeds You" (Technical Forum), December 1978 BYTE, page 184.*

New from SSM.



80 Character Video

With 80 characters per line our VB3 is the perfect video interface for word processing. It produces a standard 80x24 display of upper and lower case characters or as much as 80x51 for a full page of text. The matrix for graphic display goes up to 160x204. And with optional EPROM, as many as 256 user programmed characters or symbols can be produced.

VB3 is memory mapped for rapid screen updating. But it occupies memory only when activated. So one or more VB3s can be located at the same address with a full 65K of memory still available to the user.

It generates both U.S. and European TV rates and meets the new IEEE S-100 standard. Other features include keyboard input, black on white or white on black, one level of grey, underline, strike thru, blinking char., blank-out char., and programmable cursor. Software includes a CP/M compatible driver and a powerful terminal simulator.

VB3 is available in several configurations. Retail prices start at $375 kit, $440 assembled.

Z-80 CPU

We spent over a year designing the CB2 to assure that it will be the most fully S-100 compatible Z-80 CPU on the market.

It operates at 2MHZ or 4MHZ by DIP switch selection and includes two sockets for 2716/2732 EPROMs or TMS 4016 2K RAMs. Memory sockets can be disabled. Separate run/stop and single step switches allow system evaluation without the benefit of a front panel.

CB2 also features an MWRITE signal, firmware vector jump, and an output port to control 8 extended address lines (allowing use of more than 65K of memory). Jumper options generate the new IEEE S-100 signals to insure future S-100 compatibility.

Retail price—$210 kit, $275, assembled.

8080 CPU

Our new CB1A is identical to our popular CB1 with the exception that the on-board RAM has been increased from 256 bytes to a full 1K.

It also features an optional 2K of 2708 EPROMs, power-on/reset vector jump, MWRITE, parallel input port with status and DIP switch addressing.

Retail price—$159 kit, $219 assembled.

SSM

2116 Walsh Avenue
Santa Clara, CA 95050 (408) 246-2707

Send for our free brochure and find out why SSM has become the favorite of discerning Hobbyists and OEMs.

Our line. CPU, Video, I/O, RAM, EPROM, EPROM Programmer, Music, Prototyping, Terminator, Extender, and Mother boards. Available assembled or as kits.



Letters

Disputed Analysis of Frequency

The article "Frequency Analysis of Data Using a Microcomputer" (December 1979 BYTE, page 10) by Dr F R Ruckdeschel would have been very useful, if he had not made one disastrous error: he did not realize that Fourier coefficients for discrete, equally spaced data points can be validly calculated *only* at certain discrete frequencies. This error caused the wide smearing of the frequency plots shown in the article. These plots should have shown very sharp maxima, with little or no amplitude at other frequencies.

I devised a version of his program that now gives the correct results. My program shows that his figure 2 (page 18) was correct, but that figure 3 was incorrect. In figure 3, essentially all of the energy was actually in the first frequency, as would be expected. The only energy present in the other frequencies was due to the inexact input data, and to round-off errors during calculation.

My analysis of a square wave (his figures 5, 6, and 7) differs. A square wave should contain only odd frequency components. My analysis of a sixty-five-point, eight-period sine wave (his figures 10 and 11) also differs. My plot shows that essentially all of the energy is in frequency number 8, as would be expected.

My analysis of a sixty-five-point, eight-period sine wave with random noise added shows that there is now some energy distributed among other frequencies, due to the noise component.

The major changes to the program include:

1) It now calculates only the discrete frequencies that are valid. These valid frequencies correspond to sine (or cosine) waves with one complete cycle, two complete cycles, three complete cycles, etc, in the data. This can be visualized most easily by setting the data end to end, to form a complete loop; then the only valid frequencies are those that can fit around the loop without having any discontinuity.
2) Lanczos' method is used to prepare the data; this reduces the amount of calculation by one half (for longer problems) and also reduces the round-off error. (See Lanczos, C, *Discourse on Fourier Series*, Hafner Publishing Co, New York, 1966, page 119.) The data is folded at the center, and the sums and differences are calculated to make two new series of numbers, each set one-half as long as the original data set. The trend is also removed, to allow analysis of data that has a straight-line, up or down trend. Calculation of thirty-two frequencies for sixty-five data points now takes just over 2 minutes.
3) The amplitude and phase are calculated for each frequency. Note that frequency 0 is the base level of the data, frequency 1 is for one cycle in the data, frequency 2 is for two cycles in the data, etc. The phase is given in degrees, and is checked for a 0 sine-coefficient (which would give a divide-by-zero error), and is adjusted to the proper quadrant (in the 0 to ±180 degrees convention). The number of valid sine and cosine coefficients that can be calculated for a set of data are equal in number to the number of data points. (The 0 and $(N-1)/2$ frequencies have only a cosine coefficient.) Beyond this point, the absolute values of the sine and cosine coefficients repeat (this is called *aliasing*). A message is printed on the table at this point.
4) In the frequency plots, the amplitude tends to decline sharply at first, then more slowly. To compensate for this, I plot energy for each frequency instead of amplitude. Energy will tend to remain constant for all frequencies, making higher levels stand out more clearly. I also plot bar graphs instead of only the maximum level, and for clarity label each bar. The 0 frequency is not plotted, as it has no bearing on the frequency spectrum, and only valid frequencies are plotted.

With my revised program, meaningful frequency analysis of data is much easier.

Delmer D Hinrichs
2116 SE 377th Ave
Washougal WA 98671

Reply from the Author

I received several interesting letters regarding my article "Frequency Analysis of Data Using a Microcomputer," December 1979 BYTE, page 10. Most of the letters were in reference to errors on

The best supported personal computer you can buy.

Circle 5 on inquiry card.

pages 3 and 4 of the magazine, the "In the Queue" and "In This BYTE" sections. My program was referred to as a Fast Fourier Transform, or FFT. It obviously is not, and that choice was intentional (as you will see later). I assume someone on the editorial staff scanned the article, saw a reference to FFT, and made a simple mistake.

One particularly long communication was that of Delmer Hinrichs. He states that there is a "disastrous error" in the analysis, and goes on to provide a revised program which, in one case, shows the energy in the eight-period sine wave to be concentrated at one frequency, and not the "wide smearing" my figures showed. I am afraid Mr Hinrichs fell into a trap which I intentionally avoided.

The exact solution for the spectrum of an eight-period sine wave is well known. It is simply a "sinc" function centered on the continuous sine-wave frequency, W_0 (in radians):

$$F(W) = \frac{\sin[(W-W_0)\times 8\pi]}{(W-W_0)\times 8\pi}$$

A comparison of a plot of this expression with figure 10 (page 28) will show my results to be in very good agreement with theory in the vicinity of the fundamental sine-wave frequency (the discrepancy near $W=0$ will be discussed shortly).

The sinc function has many zeros and small peaks, as can be seen from figure 10. Mr Hinrichs's program calculates the values for the central peak and the zeros. His program misses all the small peaks. It is no wonder that he concludes that all the energy is at one frequency! If all the energy were at one frequency, how would an eight-period sine wave, preceded and followed by zero signal, be distinguished from a continuous sine wave?

The problem Mr Hinrichs experienced is typical of the subtleties embedded in many discrete Fourier transform (DFT) and FFT algorithms. Often the calculation, by the way the algorithm is economized, implicitly assumes that the signal repeats outside the "window" over which the integral approximation is to be performed. A repeating eight-period sine wave is just a continuous sine wave, which is what Mr Hinrichs's calculation told him. I avoided these algorithms and just performed a simple approximation of the Fourier integral.

I am just as guilty of believing the computer as Mr Hinrichs is. There is an error in the program of listing 1 (page 14), and this was kindly pointed out by Mr H L Cunningham. For the sake of plotting, I shifted up the data, thus adding a DC component. The Fourier transform of the shifted data was calculated, and the DC component was subtracted out. However, the same sinc function effect caused some energy spread into the frequencies near DC, and I did not correct for that. When you spend much time looking at frequency plots, you see what is expected. I saw the zero DC term and the smear near the fundamental frequency, and not the fairly obvious anomaly near DC. The program corrections Mr Cunningham has provided are shown below:

```
Add: 681 REMOVE DC SHIFT
     682 FOR I = 1 TO N
     683 D(I) = D(I)-B
     684 NEXT I
```

Remove line 810 and lines 1250 thru 1280. The last statement should be:

```
1240 RETURN
```

These changes do not affect the discussion of the frequency-shift keying (FSK) technique used in cassette recording.

I wish to thank the readers who have written to me, and I apologize for any inconvenience.

F R Ruckdeschel
773 John Glenn Blvd
Webster NY 14580

BYTE Replies

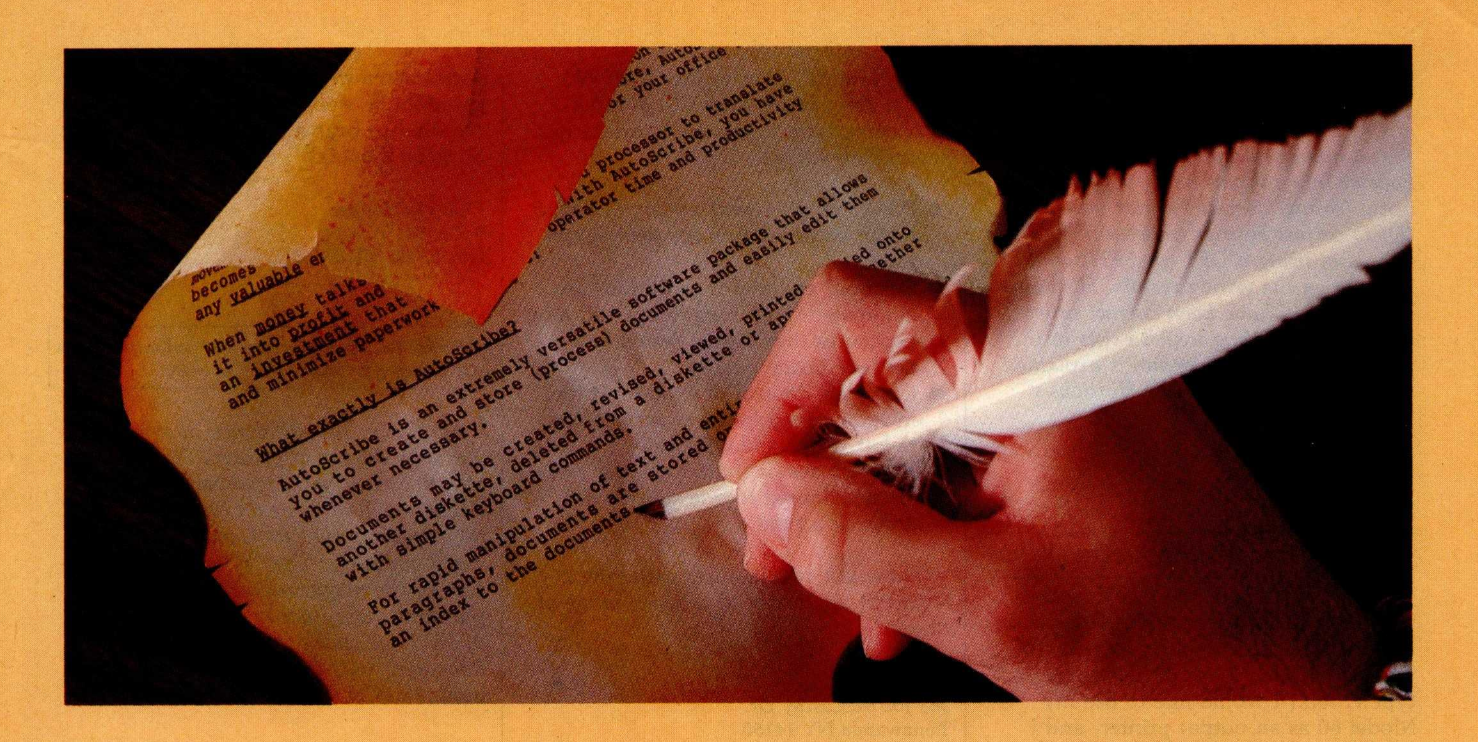
The description of Dr Ruckdeschel's article as being principally about the fast Fourier transform was indeed a mistake made by a member of the BYTE editorial staff. We apologize to those readers who may have suffered confusion due to this error.

A Dead Transformation?

Baron Jean Baptiste Joseph Fourier arose from his grave to award the Golden Bomb Award to F R Ruckdeschel and BYTE magazine for generating and publishing such "gross" frequency specta in the name of Fourier (in Ruckdeschel's article in the December 1979 BYTE).

A quick glance indicates that line 300 in listing 1 should use 2π(6.2831), and line 710 should read TO K1 where K1=(N+1)/2. Even worse is the lame explanation for the "unexpected" result rather than finding the "bug." Since I am sure BYTE will receive many letters on this, 'nuff said.

Sid Gear
72 Heritage Dr
Rochester NY 14615



The Masterpiece Machine

AutoScribe™ and Your MicroComputer

Word Processing Anyone Can Operate. Immediately.
If you've seen other word processing systems, you probably find it hard to imagine. You know other systems require special codes and initials, secret words and annoying pauses, before you can even *think* about creating copy.

AutoScribe is ready to perform at the touch of a key.

With just a handful of simple, logical keyboard commands, the AutoScribe user rapidly learns to create, revise, generate, duplicate, edit, store and retrieve . . . effortlessly and conveniently.

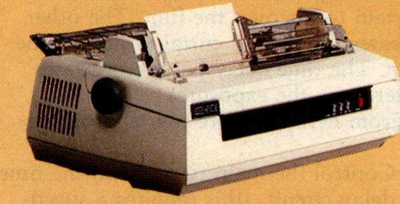
Word Processing That Gets Results
With AutoScribe, every document is a masterpiece . . . justified columns, letter-perfect correspondence, reports that impart the impact of a discerning professional.

Performance? Global search and replace, block move and copy, infinite reverse scroll, page numbering, mailing list merge for customized letters, complete format flexibility . . . the traits of the most advanced state-of-the-art in word processing are standard features of AutoScribe.

AutoScribe puts word processing in Proper Perspective
Word processing should be an efficient, cost-effective business tool . . . not a mysterious and cumbersome operation requiring weeks of training and highly specialized, expensive hardware.

Supported by lucid, self-teaching documentation, AutoScribe makes your general-purpose microcomputer into an easy-to-use but sophisticated word processor to efficiently complement your other business applications.

Make Your Micro Into a Masterpiece Machine
Put AutoScribe to work in your business operations. Now available for CP/M operating systems and Zenith-Heath systems, as well as double-density NorthStar systems. AutoScribe is also available as a complete turnkey system, including: fast Z80 processor with dual ports and two disk drives for double-density and quad-density floppy disk storage, letter-quality printer, and professional text-editing videoterminal.



AutoScribe™

MICROSOURCE T.M.

See your MicroSource™ dealer for other powerful, user-oriented applications software: LedgerPlus™-the company bookkeeper, Bookkeeper™ — the office accountant, MoneyBelt™ — the money manager, TimeKeeper™ — the time accountant. For the MicroSource dealer nearest you, call (602) 894-9247, and ask for Customer Service. Or write us at 1425 W. 12th Pl., Tempe, AZ 85281.

Circle 6 on inquiry card.

Further Reply from the Author

Mr Gear's "quick glance" was a quick error. He failed to observe (as others) that a numerical approximation to the Fourier Integral was being performed, not a formal discrete Fourier transform (DFT) or fast Fourier transform (FFT). In this case, using a DFT (or FFT) would have given the wrong *results. His comments would have been correct otherwise. The only bug which exists in the program (as far as I know) is explained in the response to Delmer Hinrichs's letter (see above).*

F R Ruckdeschel

Information Requested

Are any of my fellow BYTE readers willing to share information with me on interfacing microcomputer systems to the IBM Models 50 or 60 electronic typewriters? I would like to use my Model 60 as an output printer, and I would appreciate some advice, if any is to be had.

Thanks very much.

Michael Pinneo
3757 Vienna Dr
Aptos CA 95003

Eclipsing Mechanical Pipe Dreams

In looking through back issues of BYTE, I came across an editorial by Carl Helmers regarding the control of a camera with a computer. ("Computers and Eclipses," July 1979 BYTE). Though this is probably too late to help Mr Helmers with the February 16 event, it may be of interest to others.

The mechanical interface described by Mr Helmers is dictated by his choice of camera body. The new generation of 35mm cameras are mostly electronic, and therefore more directly controllable by computer. In general, there are two electromagnets. One releases the first curtain to uncover the film. The other releases the second curtain to cover the film. The time delay between releases determines the exposure.

From here there are two approaches:

1) Control the main release and the time delay circuit (this requires a speed-select code and a trip signal).
2) Control each curtain directly, timing done by the computer (this requires only an open and close signal).

To keep the hardware as simple as possible, I would recommend the second method. Detailed information and schematics for a particular camera can be found in a service manual. (Available from National Camera Inc, 2000 W Union Ave, Englewood CO 80110.)

A completely electronic interface has several advantages:

- Power requirements are simplified; a major consideration for field equipment.
- Solenoid and motor vibrations are eliminated; with long lenses and long exposures they would seriously degrade image quality.
- Complete control of exposure time, including long timed exposures and in-between standard speeds.
- Random access shutter speeds; you are not limited to one step up or down at a time.

These last two features make the instrument applicable to a wider range of tasks.

William Earl
363 Joe McCarthy Dr
Tonawanda NY 14150

*See the Editorial in the March 1980 issue. . . .***CH**

Nose It All

My comment concerns the smell (yes, literally the smell) of BYTE. When the December 1979 issue arrived, I sensed the same odor that one sometimes encounters in large discount chain stores, associated with plastic foot-gear and, no doubt, a rampage of other products as well. As this substance, the one responsible for the odor, has brought on attacks of asthma, I gave the issue a wide berth, reading it only in well-ventilated surroundings for brief periods of time. I escaped without any obvious damage to my health.

I assumed that, somehow, the issue had come too close to some offensive item while enroute to me, or that a not-to-be-repeated mistake had occurred during the production of the magazine. Alas, I was wrong, for the issue which just arrived, January 1980, exudes the same noxious particles/vapor.

Perhaps I, alone among your readers, am overly sensitive to whatever new manufacturing process is producing this "air pollutant." In that case, the solution to the problem is simple and is up to me. However, I write in case there are others who are similarly affected by it, in which case the substance might be considered at fault. In fact, my reaction might be likened to that of the miner's canary, warning others of a potential threat.

If you choose to, you are welcome to publish this as a letter to find out if enough others have been bothered to warrant removing the cause. It would certainly be a shame if BYTE were required to bear a legend devised by the Surgeon General.

Philip K Hooper
5 Elm St
Northfield VT 05663

> Warning: The Surgeon Corporal May Yet Determine That BYTE Reading Is Dangerous to Your Health.

*Seriously, the difference in smell is due to a change in printers that became effective with the December 1979 BYTE. Readers will observe an improvement in the magazine that took place simultaneously. The "What's New?" section of the magazine is now printed on the same glossy-paper stock as the rest of the issue, rather than on the uncoated, buff-colored stock previously used. . . .***CH**

Reform = Neologism

In language usage it often happens that one person's sensible reform is another's unjustified neologism. I was reminded of this by Philip Bacon's letter in the December 1979 BYTE, "Problems 1 Thru Ten," page 78. He objects to using numerals to represent small numbers within English text. His claim to have to mentally translate such numbers into words in order to recognize them seems amazing to me, having never experienced any such difficulty myself. Nevertheless, if BYTE doesn't mind using a little extra space to spell out numbers for Mr Bacon's benefit, then I have no objection either.

As a matter of fact, I would like to direct your attention to the far more abominable abbreviations recently coming into use for designating the fifty states. By the principle of ironic symmetry I can expect that Philip Bacon has no problem with them. When I, however, encounter an address in the state of "MN" it is my turn to go through a kind of mental stuttering: "Maine? Montana? Michigan? Where the devil is that ZIP code directory?"

It is obvious that the post office is pushing these state codes so that computerized records need allocate only two characters to name a state, whether two characters suffice for human intelligibility or not. This is the most blatantly dehumanizing misuse of computer technology that I have yet seen.

Craig Busse
Systems Analyst/Chicago Office
Canon USA Inc
140 Industrial Dr
Elmhurst IL 60126 ■

Using the Computer as a Musician's Amanuensis

Part 1: Fundamental Problems

Jef Raskin
Apple Computer Co
10260 Bandley Dr
Cupertino CA 95014

It is the dream of many amateur and some professional composers to have a machine that relieves the tedium of writing down musical ideas. The notation of music is not terribly difficult to write, but it takes a number of years of practice before you can do it quickly and legibly. Unfortunately, many composers never attain the goal of readability.

There are several kinds of systems that might appeal to a composer who wants good-looking scores. One might be a display-based music editor. Picture the composer seated before the display, light pen or graphic tablet in hand, writing on the display much as he now writes on paper. The computer's editing power would just make the process easier and more efficient. This is fine for the composer who does not use a musical instrument as he composes, but who sits at a desk with pencil and paper and is able to write down musical thoughts without having to play them.

Other composers actively use an instrument as they write, much as some people write prose more effectively by dictation rather than with a typewriter or a pen. It is this kind of keyboard-based system that is discussed here.

Most modern musicians never learn to write musical notation at all. Many never even learn to *read* music (for example, at least nine out of ten guitarists are musically illiterate — however well they might play). I am always amazed at this lack of literacy, not only among guitarists, but also among other performers. For some reason, music teachers rarely expect their students to be fluent at writing one of the most widely adopted notations that mankind has invented. Once you learn to read music, then printed music from almost anywhere in the world is open to you.

The notation of music has changed little since the seventeenth century, and it takes relatively little additional study to play from many musical scores written 500 years ago. The same is not nearly as true for certain spoken languages.

(However, this is not to say that music notation has not changed at all. I have heard many pathetic performances of Baroque and earlier music put on by singers and instrumentalists who did not realize that today's notation of music, while maintaining much the same *appearance* as Baroque notation, has often changed in *meaning*. The notation of rhythm in French Baroque music in particular is radically different from what it appears to mean to a person trained only in twentieth century notation. This problem is delightfully documented in Thurston Dart's book, *The Interpretation of Music*, Harper Colophon Books, 1963.)

There is an interesting parallel with computer languages here: when I receive a piece of music for the piano, written in Japan, I can read and play the music even if I cannot read the title and dedication. Similarly, when I have a BASIC program for my APPLE II computer, written in Japan, I can follow the program and "play" it on my computer, even though I cannot read the title or REM (remark) lines. I somehow suspect that BASIC will not last 500 years, but who knows?

Why Use Computers in Music at All?

Most people expect at least one of four musical benefits from their computer:

1. The computer as instrument: the system will create sounds and give the user new sonic effects and musical control far beyond the abilities of synthesizers now available — or do the same things simpler and more cheaply.
2. The computer as virtuoso: it will be programmable so that it can play pieces that people are technically incapable of performing.
3. The computer as piano roll: the computer will capture the performances of musicians much as a good player piano can, and will enable the recreation of their exact performance upon demand. Being able to do some editing is usually part of the deal.
4. The computer as amanuensis: the computer will listen to a person hum or play a tune (or be attached to their instrument) and write down what he is playing.

There are many other applications of computers in music, but these are the four dreams that most people confess

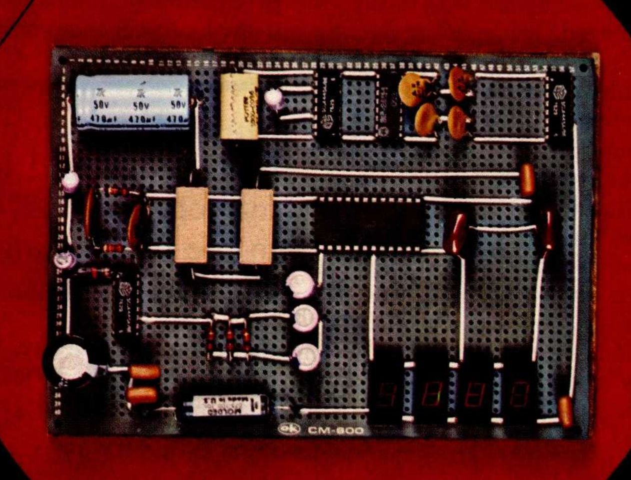
About the Author

Jef Raskin's credentials in music include his years as a professional musician and music teacher. He is presently the manager of Advanced Systems at Apple Computer, Inc. His personal music and computer equipment includes a piano, a harpsichord, an organ, a Digital Equipment PDP-11, and three Apple II computers.



CM-600 Circuit Mount





CM-600 $6.95*
RW-50 $2.98*

NEW CM-600 SOLDERLESS PROTOTYPE BOARD

CM-600 is a unique system for solderless construction of circuit prototypes, useful to both engineers and hobbyists. The CM-600 is a neoprene board $4\frac{1}{2}$" (114mm) x 6" (152mm) with 2280 holes on .100" (2.54mm) centers. Standard components including DIP's are mounted by simply inserting leads into the holes in the long life neoprene material. Interconnections are easily made using 20 or 22 AWG (0,8 or 0,65mm) wire jumpers. Positive contact is assured by the elasticity of the hole, which compresses the leads together. To remove components or leads, simply pull out. This facilitates easy circuit changes making it ideal for breadboarding experimental circuits. CM-600 also features numbered rows and columns for easy reference. Accessory Kit RW-50 contains 50 pcs of AWG 20 (0,8mm) insulated jumper wires of assorted lengths from $\frac{1}{2}$" (13mm) to 4" (100mm). Both ends are stripped and bent 90° for easy insertion. In stock directly from

OK Machine & Tool Corporation
3455 Conner St., Bronx, N.Y. 10475 U.S.A.
Tel. (212) 994-6600 Telex 125091

*Minimum billings $25.00, add shipping charge $2.00
New York State residents add applicable tax

Circle 8 on inquiry card.

to me. Most of the other applications fall into musicological, physiological, psychological, or acoustical studies. None of these applications will be discussed in this article.

Item 1 (using computers as synthesizers or as their components) is being done all the time, with varying degrees of success. Popular music's use of synthesizers has often been quite effective, whereas the highbrow use of computers in music has more often had results that are merely bizarre.

Item 2, using the computer to play conventional instruments, is coming along nicely — at least as nicely as can be expected. It has an interesting problem: a true virtuoso performer plays a bit differently each time. Different virtuosi play quite differently from one another. These differences are called *interpretation*.

Interpretation is one of the things that makes listening to live performances much more interesting than listening to recordings which do not vary from one playing to the next. Few people have even thought about, much less attempted to write algorithms to solve, the problems inherent in getting a computer to "understand" a piece of music so that it can create a viable interpretation. Without the ability to interpret a piece, the virtuoso computer is trivialized to item 3, a piano roll.

Some people have set up the computer to be an automatic recorder-player, in the tradition of the Welte Vorsetzer (roughly translated: that which sits in front) system of the last century. Player pianos effectively became extinct, and history will probably repeat itself with this idea. Who wants to have to maintain, for example, a piano, when a simple record player can reproduce the sound of not only the piano, but of every other instrument ever invented? Besides, the record player is cheaper and does not go out of tune as easily.

But of all the dreamers mentioned here, among those least prepared to turn their dream into reality are those whose dreams turn to item 4, transforming played music to the written form. They are the composers of the future, whose musical ideas need but the invention of the automated amanuensis for them to become rich, famous, or both. They well may be right, but they are usually unaware of the subtle problems that lie across their path.

Problems in Building the Composer's Aid

Every now and then, I read about a company that has begun to manufacture such a device, normally found in the form of a piano with a computer and a plotter as peripherals. The trouble is, you will usually read about them but once. They are seldom heard from again, except when they announce some "technical difficulties" that will delay the mass production of their device until next year. I suspect that some of them put the correct hardware together, announce the product, leaving only the writing of a few programs to finish the job.

Musical notation contains both more and less information than is contained in the performance.

Well, dear reader, that bit of programming *is* the job. I have no doubt that a successful device is or will eventually become available. Its existence will mean that someone has come up with some heuristic solutions to the rather interesting and difficult problems involved. As you will see, these problems cannot be solved in the sense that certain equations can be solved to give a definite, fixed answer. All that a solution to the computer-generated score problem can be is a more or less useful approximation, which will require human editing in most cases. The rest of the article explains why this is the case.

Three Parts of the Problem

First let us look at some of the technical difficulties. One portion of the job is quite easy, and another is not considered to be difficult. The third portion is nearly as difficult as climbing Mount Everest on roller skates.

Assume, for the time being, that the input will be via a piano-style keyboard. Getting this arrangement to work is the very easy portion of

We see the Apple a little differently.

We see it as a good way to get things done.

Apple has built a great computer. We at CCS have built a great line of peripherals and components to expand the Apple. To do almost anything you want to get done with a computer.

If you want to do business with an Apple, we've got tools to connect the Apple to standard business printers and terminals. Or to modems, for communications over telephone lines, with other computers, even with other Apples.

If you want to apply your Apple to engineering, scientific, or graphic projects, we've got tools for high-powered, high-speed math functions, and fast, high resolution graphics. And tools to connect the Apple to lab test equipment like function generators or plotters.

And we have tools to connect the Apple to the outside world, including A/D converters and interval timers with external interface.

We make components for the S-100 bus, the PET, and the TRS-80, too. We built our products to deliver hard-nosed value to the OEM, and to the inventor who knows the best, at prices that are unbeaten.

To find out how much computer your Apple II can be, see things our way. Because for serious users with serious uses for the Apple, we've got the tools.



California Computer Systems
250 Caribbean Sunnyvale, CA 94086 (408) 734-5811

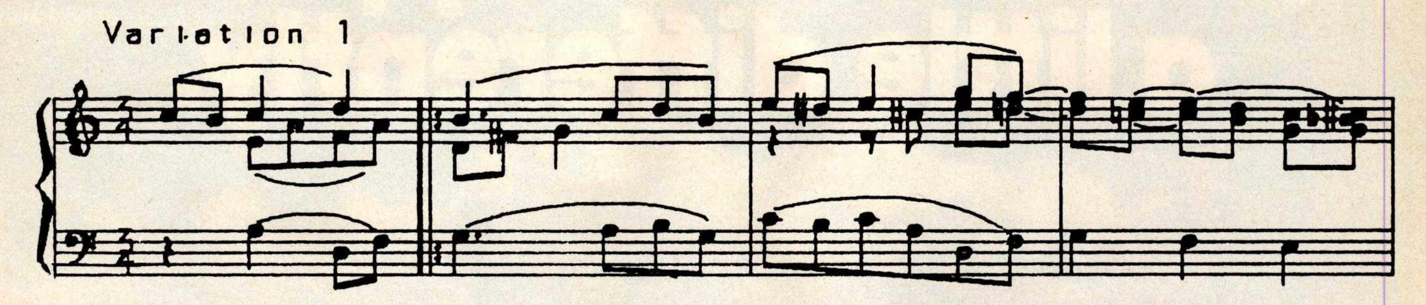


Figure 1: *A section of Beethoven's "Variations on 'God Save the King'" done on the computer. When done correctly, computer-drawn music is indistinguishable from printed music. Only the time signature reveals the computer origin of this sample. The author programmed the music system that produced this in 1967.*

the problem. It is no great feat to be able to attach a keyboard to a computer — there is even an integrated circuit that does it for you (Intel's 8279, for example).

The minimally difficult part of the job lies in getting the computer to produce what looks like printed musical output of acceptable appearance (for an example, see figure 1). It will take an experienced programmer a year or so to write programs that can achieve a good-looking music output from a computer system, unless he has a powerful graphics system to use. For minimally readable music notation, you should figure a month or two for the programming job. I am not talking about drawing just a single melodic line, but drawing full scores with all the slurs, beams, and other complex notations that composers use.

The *very* difficult portion of the problem is to go from the computer's internal representation of the keypresses to standard musical notation. The processes at the two ends are readily accomplished; it is the transformation from one to the other that is very difficult.

It is difficult enough to go the other way, from standard musical notation to a reasonable performance: musicians find that it takes years of training even to do that apparently straightforward task. But we will concentrate for now on the problem of going from the keyboard input on a piano-style keyboard to graphic output in standard musical notation.

The first obstacle that deters many a hopeful attempt is the fact that musical notation contains both more and less information than is contained in the performance. To see this clearly, let's simplify the problem slightly. If we cannot solve the simplified problem satisfactorily, it is unlikely that we will be able to solve the whole problem.

A Musical Instrument to Keep in Mind

One of the simplest instruments to computerize is the pipe organ. Its keys are in either an on or off (down or up) state, unlike a piano, where the manner in which the keys are struck makes a difference in the sound. (Note to organists: in this instance I am not talking about tracker-action organs; rather, I am talking about the usual electromechanical pipe organ, which is operated electrically from simple contact closures in the keys.)

Another important simplification: real pipe organs often have the ability to produce a number of different timbres or sound qualities. We will limit the organ modeled here to what organists call a single *registration*,

meaning that the tone color (timbre) of the instrument cannot be changed. This is not too severe a limitation, as much of J S Bach's music can be played very beautifully with only one registration.

For the rest of this discussion, then, this simple pipe organ will be a useful model of a musical instrument to keep in mind.

Four Views of a Piece of Music

Before proceeding with the musical and technical details of the most difficult portions of the Composer's Aid, it might be a good idea to make sure that you and I are using the same terms in the same way.

A piece of music, for this discussion, has four major embodiments. First, there is the *musical idea*, which exists in the mind of the composer. It may evolve as it is performed, as in improvisation; it may never be realized, or it may be written down. This last activity is termed *composing*.

Second, there is the *score*, which is a written document (usually in musical notation) that describes how to play the piece. We will ignore the suggestive descriptions that often accompany the piece, for example: "andante cantabile con moto appassionato," or as Fats Waller used to write, "Tempo Basement De Luxe." The only portion of the score that will interest us for now is the collection of splotches of ink that, by their shape and position on the page, indicate the action to be taken by a human or mechanical performer.

The third embodiment consists of a sequence of switch closures or *keypresses* on the keyboard. Such an embodiment is represented by a piano roll. On the organ, this embodiment can be represented mathematically as a sequence of ordered pairs, the first of which states at what time the key was pressed, and the second stating for how long an interval the key was held before being released. In practice, these times need not be more accurate than to the nearest hundredth of a second (so long as errors do not accumulate).

The fourth embodiment is the *sound* of the piece. This is what the composer primarily seeks. Many computer hobbyists overlook the fact that the score, the performer, and the instrument are just means to an end. Perhaps the ideal world would be one where the composer thinks up a piece, and some gadgetry attached to his head picks up these mental emanations and realizes them as sound — or perhaps disseminates them directly into the audience's brains. For the time being, though, we prefer to go through this last embodiment and hear the piece through our ears. Direct mind-to-mind music we will leave to the science fiction writers.

Getting Tripped Up by Rhythm

Now that we have our corner of the computer-music world carefully delineated, our model instrument chosen, and the stipulation made that it is not difficult to have a computer read a keyboard and produce musical notation, let's look at some of the more difficult aspects. One such aspect is having the computer proceed from its reading of the keyboard to the production of written musical notation.

If, due to someone's inspiration, what I am about to declare as being difficult to do turns out to be easy, I will be delighted. But read on and find out *why* it may be difficult.

A piece of music that consists of only one note played at a time (a simple melody) can be captured by the computer by simply storing the time at which the note begins, and then storing the length of the time interval that the note continues to sound. It is convenient to measure these times in hundredths of a second. It is also convenient to say, by convention, that the time the first note begins is called time 0.

For example, if the first note lasts 1 second, we say that it starts at time 0, and has a length of 100. If the second note starts half a second after the first note stops and is half a second in duration, then we say that it starts at time 150 and has a length of 50.

The rate of playing a musical piece, its *tempo*, is given in terms of Maelzel's metronome markings: the number of notes of a given metrical type (such as quarter or eighth notes) that are to be played in 1 minute. Incidentally, since the metronome was not available until after 1816, tempi of pieces composed before that date can rarely be ascertained with any assured accuracy.

Figure 2 presents the notation that tells us to play exactly 120 quarter

Now! North Star Application Software!

North Star now offers application software for use on the HORIZON! Now you have one reliable source for both hardware and software needs! The first packages available are:

NorthWord—
NorthWord is a simple-to-operate word processing system designed for use with the popular North Star HORIZON. NorthWord enables you to increase office efficiency and cut document typing time and cost. NorthWord incorporates the most sought-after word processing features: easy editing, on-screen text formatting, simultaneous document printing, and much more. NorthWord can be integrated with other North Star software packages to produce customized letters, labels and reports quickly and efficiently.

MailManager—
MailManager enables you to compile and maintain complete organized mailing lists. Lists are easily accessible and can be compiled with a great deal of flexibility. Entries, corrections and deletions are easily made. The North Star MailManager can print your list on individual envelopes, on mailing labels, or in compact summary form.

InfoManager—
InfoManager is a powerful list-oriented, data management system. It will accept up to 50 categories of information for each record and has the ability to select and sort before printing. The North Star InfoManager has power and flexibility for many applications: product inquiry, inventory, customer/client records, calendar reminders, and as an easy way to fill in often-used forms.

GeneralLedger—
General Ledger and Financial Reporting, two programs in one, maintains general ledger accounts based on such input as checks, bank deposits and journal entries, and uses the information in the general ledger to produce customized financial statements and financial reports.

NorthWord is the central building block for all the North Star application software to follow. Packages now being tested include other accounting and professional application packages. For more information or a demonstration, contact your local North Star dealer.

NorthStar

North Star Computers, Inc.
1440 Fourth Street
Berkeley, CA 94710
(415) 527-6950
TWX/Telex 910-366-7001



notes in 1 minute. Each quarter note will have a length of 50/100 of a second.

The first significant problem occurs right here. Have a person using a metronome play on some instrument six quarter notes, in succession, at this tempo. There is no difficulty in having the computer find when and for how long each note is played. The resulting data might well look like the data in table 1, which came from an experiment conducted with a push-button switch attached to my Apple II computer.

The data was produced from the playing of an experienced musician and yet is irregular. There are two reasons the results from this very simple piece seem so ragged. First, so that several notes played consecutively at the same pitch may be heard as distinctly separate events, the actual duration of each note must be shorter than the indicated length in order leave a short period of silence between each instance of the note. Thus the length of a note will not be exactly half a second (50/100 of a second) nor will it average this length, but something less. In this case the duration averages to 30.5 hundredths of a second.

Another reason the note inceptions are not as regular as we might hope lies in the normal variations in human motion. The average time between the notes is 53.6 hundredths of a second.

Now that we have the starting times and lengths, how would we notate the piece *as played*? The player was thinking of six equal notes, filling a measure as shown in figure 3. But the computer heard nothing of the sort. It received a sequence of rather irregular numbers. It would require some clever programming to determine that all of those notes were intended to be the same length. A moderately clever program might produce the music notation shown in figure 4.

The program seems to be struggling to accurately fit the notes it "hears" into the pattern of 120 beats to the minute, and losing the struggle.

Figure 2: *Markings for tempo. The notation above and to the right of the treble clef tells us to play this musical passage at a rate such that 120 quarter notes can be played in 1 minute.*

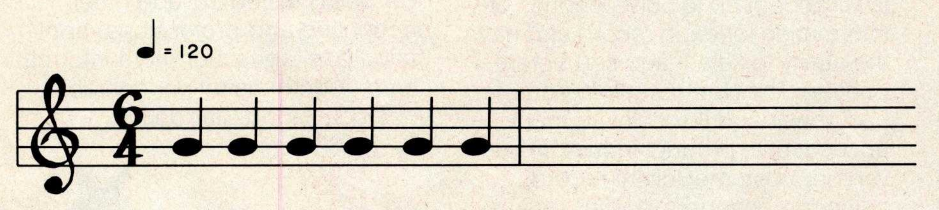


Figure 3: *Music notation for six equal quarter notes. When a human player tries to play these notes, the results, as strictly interpreted by an unsophisticated computer program, may be interpreted differently. See figure 4.*



Figure 4: *Possible computer interpretation of six quarter notes. When the keystrokes entered by a human attempting to play six notes of equal duration are interpreted, even a fairly good computer program might interpret them as something quite different. The notes here are: a dotted eighth and a sixteenth rest (two times); a eighth note and an eighth rest; a dotted sixteenth note, a thirty-second rest, and an eighth rest; an eighth note, a thirty-second rest, and an eighth rest; a dotted eighth note, a sixteenth rest, and a thirty-second rest.*

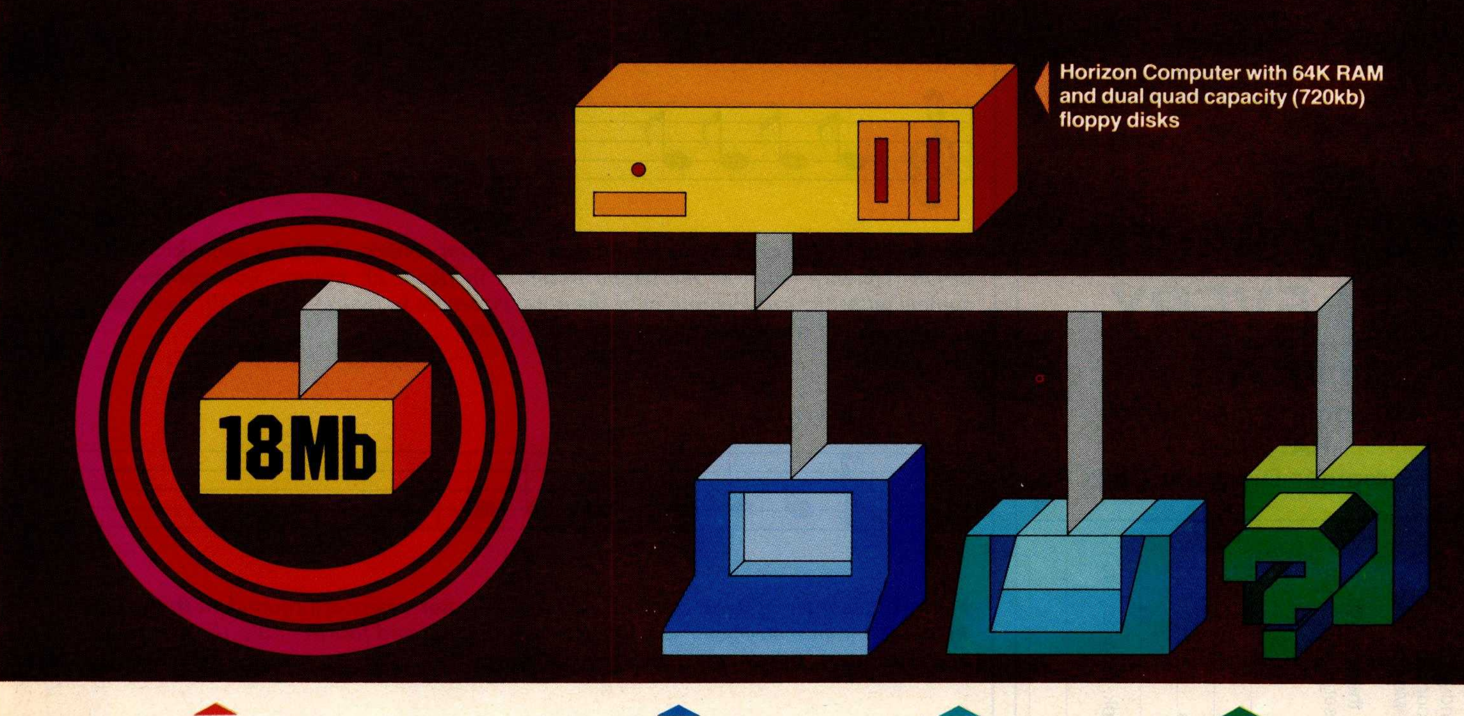
Note	Starting Time (1/100s)	Note Length (1/100s)	Comments
1	0	32	The first note started at time 0 and lasted 32/100 seconds.
2	53	34	The second note started 53/100 seconds after the first.
3	101	37	The third note's starting time and length, etc.
4	167	22	
5	210	28	
6	268	30	

Table 1: *Results of an attempt to play six notes of equal length. The starting times and note lengths, each measured in hundredths of a second, were derived from a computer program written for the author's Apple II. The program recorded the times a push-button switch was pressed and released. Any computer program that has the task of converting these keypresses to standard music notation will have to decide from the note length values whether or not certain notes are meant to be equal.*

Another Rhythmic Difficulty

Matters become worse if the computer has to determine what the intended tempo is, just by hearing it. Even if the notes are played by a precise mechanism, no program can tell the difference between the notes in figure 5a and the notes in figure 5b, since they both sound the same, albeit at different tempi. Nonetheless, a human player may interpret those two notations differently. In fact, if we rewrite the six equal notes in 6/4 time (as in figure 3) so that it is in 3/4 time, the result is the notation given in figure 6.

New on the North Star Horizon: 18Mb Hard Disk Drive!



Up to four 18Mb Winchester-type hard disk drives

Display terminal

Letter-quality or dot matrix printer

Horizon I/O flexibility allows expansion to meet your needs

Unsurpassed Performance and Capacity!

North Star now gives you hard disk capacity and processing performance never before possible at such a low price! Horizon is a proven, reliable, affordable computer system with unique hardware and software. Now the Horizon's capabilities are expanded to meet your growing system requirements. In addition to hard disk performance, the Horizon has I/O versatility and an optional hardware floating point board for high-performance number crunching. The North Star large disk is a Century Data Marksman, a Winchester-type drive that holds 18 million bytes of formatted data. The North Star controller interfaces the drive(s) to the Horizon and takes full advantage of the high-performance characteristics of the drive. Our hard disk operating system implements a powerful file system as well as backup and recovery on floppy diskette.

Software Is The Key!

The Horizon's success to date has been built on the quality of its system software (BASIC, DOS, PASCAL) and the very broad range and availability of application software. This reputation continues with our new hard disk system. Existing software is upward compatible for use with the hard disk system. And, with the dramatic increase in on-line storage and speed, there will be a continually expanding library of readily available application software. For more information, see your North Star dealer!

HORIZON-HD-18
Horizon computer with 64K RAM, 2 quad capacity mini drives and one HDS-18 hard disk drive **$9329**

HDS-18
Additional 18Mb hard disk drive for expansion of Horizon HD-18, or your present Horizon **$4999**

SYS-1N
Complete Horizon HD-18 plus 80 x 24 display terminal and NEC Spinwriter printer **$13,239**

SYS-1A
Complete Horizon HD-18 with 80 x 24 display terminal and Anadex printer **$11,319**

NorthStar

North Star Computers, Inc.
1440 Fourth St.
Berkeley, CA 94710
(415) 527-6950 TWX/Telex 910-366-7001

Circle 13 on inquiry card.



Figure 5: *The difficulty of determining tempo from context. Without some kind of external reference (such as the tempo notation in figure 2), musical notation becomes somewhat arbitrary. Hearing only the note sequences in figures 5a and 5b, a computer program could not differentiate between the two.*

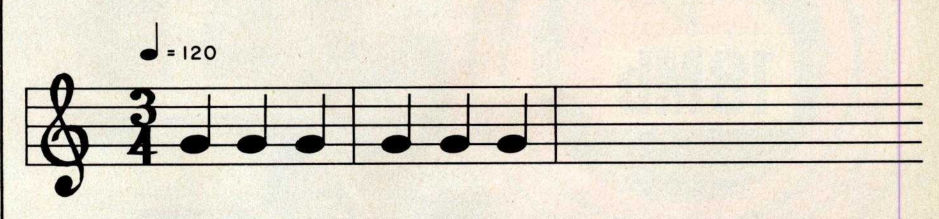


Figure 6: *Example of agogic accent. Although the notes here are equivalent to the notes in figure 3, a human player will likely accent the first and fourth notes (the first note of each measure); this is called an agogic accent.*

The human player is likely to make the first and the fourth notes from figure 6 *longer* than any of the others. This is done to emphasize them. The technique is called an *agogic accent* and is frequently used — especially on our organ, which has few other means for putting emphasis on a note.

How is the computer to know that this phenomenon is accenting and not accident? And how is it to know that it should *not* notate the first quarter note in each bar differently than the others? Clearly then a program must have some information about the metrical structure of the music. I leave it to you to determine just how this is to be accomplished. If you require human intervention too often, you might begin to abandon the computer altogether.

If our organ is located in a resonant cathedral, the organist might play the notes even shorter, perhaps for only a quarter of their indicated time, and let the resonance of the hall fill in the rest of the note. In another instance, the organist might feel inspired to play a passage staccato for other reasons. (*Staccato* means playing the notes briefly, leaving silence to make up the time between notes.) This is well within the accepted limitations of a performer's rights to interpretation.

What is the poor computer to do? Try to notate in minute and scrupulous detail the exact performance? This might be interesting if we are studying human performance. But it is not useful here, for our goal is to create a score, which we hope will be playable by a human performer, and therefore it must not be encrusted with the myriad details of a particular performance.

The more successful programs (such as Moorer's work at the Stanford Artificial Intelligence Laboratories) are adaptive and quite clever about imagining what the player must "mean" by the apparently strange sequence of timings that come into the computer in digital form. It would be a notable accomplishment for a programmer to get a computer to merely notate all *rhythms* correctly, let alone to solve the problems caused by details of harmony as well.

Next month in Part 2, I will examine more problems that arise in using the computer as a musician's amanuensis. ■

clearly readable printouts clearly remarkable price

The $625* Heathkit H14 Printer. You'll pay hundreds more for a printer with its features.

Where else can you buy a microprocessor-based printer with the H14's features and copy quality for under a thousand dollars?

The Heathkit H14 prints up to 165 characters per second, one full line every two seconds.

5 x 7 dot matrix and finest quality impact printhead give you clear, easy-to-read images.

All functions are microprocessor-controlled for reliable performance and more efficient use of your computer.

You get:

- Standard 96-character ASCII set—UPPER and lower case.
- Operator or software selectable line width: 132, 96 and 80 characters per line.
- Compatibility with any computer having RS-232C or 20 MA current loop serial interface with handshaking.
- Sprocket paper feed, with adjustable spacing, keeps paper moving smoothly.
- "Paper out" and "paper jammed" signals prevent loss of data.
- Selectable baud rates from 110 to 4800.
- Convenience of standard fan-fold paper, 2.5 to 9.5 inches wide.
- Chrome wire rack keeps paper neat.

Price includes connecting cables, paper rack and ribbon. Just add paper and you're ready to run. And service on the H14 is close by at any of 55 Heathkit Electronic Centers throughout the U.S.

Complete details on the remarkable H14 are in the newest, free Heathkit Catalog. Send for yours today or pick one up at your Heathkit Electronic Center.

"Whatever your computer, this printer is an excellent complement ...an excellent value."
— Creative Computing Magazine

HEATHKIT H14 PRINTER

FREE CATALOG See the complete line of Heathkit Computer Products, including printers, video terminals, floppy disk systems and software, in the new, 104-page Heathkit Catalog. It describes nearly 400 exciting kits for your home, work or pleasure — all at build-it-yourself savings. Send for yours today or pick one up at your Heathkit Electronic Center† where Heathkit Products are displayed, sold and serviced. See your white pages for center nearest you.



*In kit form, F.O.B. Benton Harbor, MI. Also available completely assembled at $895 F.O.B. Benton Harbor, MI. Prices are subject to change without notice.
†Units of Veritechnology Electronics Corporation

Heathkit®

Heath Company, Dept. 334-644, Benton Harbor, MI 49022

CP-180

Circle 15 on inquiry card.

Without an Eaton LRC Printer you

Get serious





are just playing computer games.

for only $389.

Introducing the New Eaton LRC 7000+ Dot-Matrix Impact Printer.

No matter what type of personal computer you now have, or are thinking of buying —

Apple	**Interact**
Cromemco	**Commodore Pet**
TRS-80	**Northstar**
TI	**Ohio Scientific**
Exidy	**and others**

— the new Eaton LRC 7000+ dot-matrix impact printer will quickly interface and be printing in a matter of seconds. You'll immediately have hard copy capabilities that will allow you to go beyond computer games and get down to serious business.

An Invaluable Addition

Adding a printer increases the practicality and usefulness of your personal computer dramatically. You'll be able to perform all sorts of bookkeeping and accounting functions — from balancing your personal checkbook to monitoring your company's inventory — and you'll have a permanent copy for your records. You'll find that whether you're controlling your family's budget, recording your program listing, plotting the



growth of a stock in the market, or any of the other thousands of analytical functions your computer can perform, a quality printer is simply invaluable. But you'll want to be sure to pick the right printer for your system.

The Right Printer



The Eaton LRC 7000+ is designed specifically for personal computers. Its plug-in simplicity makes it remarkably easy to interface with any computer. Its simple design features the fewest possible moving parts, making it virtually maintenance free. Unlike many other printers, the 7000+ can print on any type of roll paper, eliminating the hassle and added expense of purchasing a special, treated paper. Its rugged case is tough enough for industrial environments, yet attractive enough for home or office use. And most importantly, it offers the high performance and features you demand in a quality printer.

Super Performance

The 7000+ features uni-directional printing with a line speed of 1.25 lines per second. It accepts any single or two-ply paper roll from 3/4 inch to 3-7/8 inches wide, and prints a 3-1/3 inch line. Capacity is adjustable and can be 40 columns at 12 characters to the inch using the single width font; or 20 columns at 6 characters to the inch using the double-wide font. An available option allows the unit to print 64 columns at the single width setting, and 32 columns using a double width font.

An Unbeatable Price

The real beauty of the new 7000+ is the fact that you can't buy another printer that offers you all these features at anywhere near the price. Eaton LRC's 7000+ has a suggested retail price of $389.00 and comes with a 90-day factory warranty.

Specify Eaton LRC

Whether you're looking for a quality printer to add to your existing computer, or are about to buy a complete system, don't settle for less than an Eaton LRC printer. Stop by your local Computerland store or contact Quest Electronics, 2322 Walsh Avenue, Santa Clara, CA 95051, (408) 988-1640 or Sigma International, Inc., P.O. Box 1118, Scottsdale, AZ 85252, (602) 994-3436 for more information. Once you've seen the new 7000+, you won't settle for anything less. LRC, an EATON company, Riverton, Wyoming 82501, (307) 856-4821.

Master distributor inquiries welcome. Contact your nearest LRC Regional Sales Office: Northeastern office, One Lakeside Office Park, Wakefield, MA 01880, (617) 245-2730; Southeastern office, 29 Delmont Drive Northeast, Atlanta, GA 30305, (404) 231-4105; Western office, 510 Lawrence Expressway, Suite 210, Sunnyvale, CA 94086, (408) 245-1590.



an EATON company

Stop, Thief!

On Friday, February 2, 1980, a burglary was committed at the Cambridge, Massachusetts, apartment where David Mitton, secretary of the New England Computer Society, lives. Among the items stolen was the computer system that had been used to operate the Cambridge Computerized Bulletin Board System (CBBS). The following equipment was stolen:

- Processor Technology Sol-20 Terminal Computer;
- SD Systems ExpandoRam memory board populated with 48 K bytes of memory;
- Potomac Micro Magic MM-103 modem board and telephone interface, serial number 1-1155;
- North Star Minifloppy disk-controller board;
- Two Shugart SA-400-3 Minifloppy 5-inch floppy-disk drives, serial numbers A40096 and A93222 (drives were open and screwed onto a ¾-inch piece of plywood);
- Motorola video monitor.

Readers of BYTE that have any information concerning the whereabouts of this equipment are asked to contact David Mitton by telephone at work (617) 493-3154 or at home (617) 876-8718.

Personal belongings also stolen included an Advent 300 stereo receiver (serial number JO-23821), a Sanyo 625 turntable (serial number 66119191), and a Raleigh Super Course ten-speed bicycle (serial number 250525, brown with handlebar gear shifters).

T C F Rides Again

The Trenton Computer Festival (TCF) (the original Personal Computer show) will take place on April 19 and 20 1980.

The fifth annual Festival will last for two full days, with a 5-acre outdoor flea market and indoor commercial exhibitor area for up to ninety booths. There will be thirty speakers, user group sessions, and demonstrations, as well as hundreds of door prizes.

Computer conference sessions and forums will be held on microcomputers in the home, education, medicine, amateur radio, music and the arts. There will be user group sessions on Saturday and special tutorial sessions for the general public and novice on Sunday.

It is expected that attendance will exceed 9000, up from 6000 last year. There is free parking for 5000 cars. There will be a Saturday night banquet with noted guest speakers.

TCF-80 will be held at Trenton State College, just outside of Trenton, New Jersey, convenient to New York City, Philadelphia, and Baltimore.

Admission is $5 for the two days ($2 for students). The Saturday night banquet is $10. Flea Market spots are $5 per day.

TCF-80 is a nonprofit undertaking and is sponsored by: the Amateur Computer Group of New Jersey, the Philadelphia Area Computer Society, the Trenton State College Computer Society, the Institute of Electrical and Electronics Engineers—Princeton Section, and the Department of Engineering Technology, Trenton State College.

The $300 Hand-Held Coconut

A little-known fact about Hewlett-Packard is that most of its computer products visible to the average person have come from the same division. This branch of Hewlett-Packard began in Cupertino, California, under the name of the Advanced Products Division (APD). In mid-1976, APD changed its name to the Corvallis Division, when it moved to its current location in Corvallis, Oregon.

In 1972, APD started the calculator boom with the introduction of the HP-35, which was the first hand-held calculator that could entirely replace the (then) common engineer's slide rule. In 1974, APD surprised an increasingly calculator-oriented world with the introduction of the HP-65, the first user-programmable calculator with magnetic card storage.

The Corvallis Division has continued its orientation toward the personal user since its name and location change in 1976. Even before the move to Corvallis was made (some three years before the introduction of the first product), Hewlett-Packard had already devised the code names of two already-planned products, known internally as Capricorn and Coconut.

The Capricorn, Hewlett-Packard's desktop computer (officially named the HP-85), has become a popular name by which the product is known. (For a review of the computer, see Christopher Morgan's article in the March 1980 BYTE, "Hewlett-Packard's New Personal Computer, The HP-85.") However, it was only recently discovered that the other name, "Coconut," referred to the HP-41C, the extended-function hand-held programmable calculator introduced by the Corvallis Division last July.

Hewlett-Packard has a large semiconductor production line at the Corvallis plant; this facility is largely being used to produce custom integrated circuits and liquid-crystal displays (LCDs) used in the HP-41C. The Corvallis plant also manufactures a number of parts for the HP-85 computer.

Computer Camp

Children can sign up for an overnight camp in Moodus, Connecticut, where this summer's main activity will be computers. This recreational and educational experience is directed by Fairfield University professor Dr Michael Zabinski. One week is planned from June 29 to July 4. The campers, ages ten to seventeen, will have small group instruction along with minicomputers and microcomputers for hands-on experience. The camp is for children of all levels of experience. In addition to computers, the campers will have the facilities of the Grand View Lodge including swimming and tennis. For further information, contact Dr Michael Zabinski PhD, (203) 795-9069, or write, Computer Camp, Grand View Lodge, POB 22, Moodus CT 06469.

Drive Through Order Verification Screen

If you have ever ordered a hamburger and french fries at a drive-through restaurant, then waited patiently only to receive a jar of horseradish and a pound of onions, you now have the ability to stop the problem before it begins. Scan-Data Corp, 800 E Main St, Norristown PA 19401, has developed the Positran Fast Food System which eliminates mistakes by allowing customers to view their order on a video screen as it is being placed. The system has been tested at restaurants around the country. ■



OHIO SCIENTIFIC
Professional
Computers
The Challenger Line

Ohio Scientific Microcomputers for all reasons

Ohio Scientific has been building microcomputers longer than any company currently in the personal computer and small business computer marketplace. The company features a uniquely broad line of computer systems and interchangeable accessories. Ohio Scientific computer models range from the $279 Superboard II which is the lowest cost complete computer on the market to the world's most powerful microcomputer; the C3-B GT which features a 74 million byte, 10 millisecond access disk and a 300 nanosecond instruction cycle processor. Ohio Scientific computer products are sold and supported by a world-wide network of over 350 computer dealers. The product line featured in this brochure is Ohio Scientific's professional series computers, software and accessories. All machines in this brochure incorporate dual 8″ floppy disk drives and utilize the OSI 48 line BUS architecture of modular interchangeable PC cards. This architecture allows easy servicing, modification and upgrading. All machines in this brochure have internal firmware for instant disk loading and diagnostic testing and come complete with connecting cables, operating manuals and OS-65D disk operating system with extended BASIC so they can be utilized immediately when delivered by connection to a standard RS-232 terminal.

BUSINESS

EDUCATION

RESEARCH AND DEVELOPMENT

OEM

Business

The most popular use of Ohio Scientific professional computers is in small business accounting. The minimum configuration of each computer has dual 8″ floppies, 48K bytes of RAM and an RS-232 port making each computer usable in business applications as delivered. All Ohio Scientific machines can operate as single-user, stand alone computers, but by simply adding one PC board, they can also be used as intelligent terminals in a distributed processing network. Business software includes an advanced BASIC operating system; OS-65U which features end user operating ease and security as well as highly advanced file structures and communications protocols. OS-65U is unique in that programs written in this operating language are immediately upward compatible from single-user floppy systems to multi-user timeshare and/or distributed processing networks with hundreds of megabytes of hard disk. Specific business applications software include a complete word processor for use on any professional series computer (WP-2), a family of conventional fully integrated accounting systems (OS-AMCAP) and a highly advanced data base manager and information management system (OS-DMS). DMS based applications modules range from simple general accounting packages to Construction Quotation, Medical and Legal billing systems in stand alone and/or integrated single-user, multi-user and network compatible configurations. The data base structure of these packages allows a high degree of end user customization without programming through use of powerful general purpose report writers, mathematical packages and an on-line query facility.

Education

Ohio Scientific personal computers are very popular in general education. The professional series offers capabilities for advanced educational use. Ohio Scientific's C1P and C4P series computers can be connected to a C2 or C3 computer to utilize its floppy disk and printer, and to allow teacher monitoring and communications under OS-65U Level 1 operating system.

The Challenger III's unique three-processor architecture provides opportunities for students to compare architecture, machine code, assemblers and upper level languages for three types of processors on one machine. OS-CP/M further provides a wide range of language capabilities including BASIC, FORTRAN, COBOL, PASCAL, APL, FORTH, ALGOL and others. Ohio Scientific's broad range of compatible accessories include a solderless interface prototyping board, a high speed analog I/O module and a PROM blaster for use in hardware labs. OSI's home security and control I/O, unique voice I/O, and new telephone interface coupled with the fast access high capacity CD-74 hard disk provide unique opportunities for advanced computer science investigations on an educational budget.

Research and Development

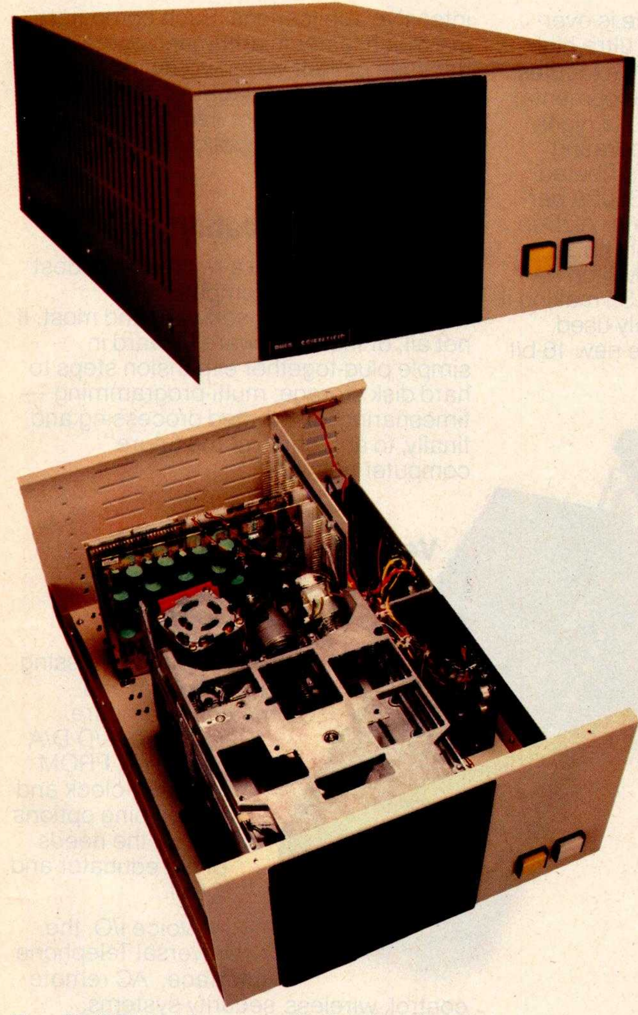
The C2 and C3 series computers feature the most advanced 6500 family operating system and architecture complemented by a fast resident interactive assembler/editor, on-line debugger and optional PROM blaster capability. The C3 extends this development system capabilities to the 6800 and Z80 family by nature of its three-processor architecture. Ohio Scientific's broad range of plug compatible accessories include a unique voice recognition breadboard, a powerful Votrax® based voice output system, a general purpose telephone interface, a fast analog I/O module, very fast high storage capacity hard disks, and computer network capabilities. These leading edge technology products provide opportunities for advanced architectural investigations and development without extensive hardware modifications. To further enhance the C3's usefulness in R/D applications, the company is currently developing a 68000/Z8000 CPU expander board which is designed to plug-in to existing C3 series computer systems.

OEM

Ohio Scientific's broad line of plug-compatible products and mass production economies provide a tremendous cost/performance benefit to both original equipment manufacturers and "systems houses".

Contact your local dealer or the factory for OEM contract details on computers, accessories, complete systems and/or subassemblies.

C2-OEM



The C2-OEM with cover off showing the placement of floppy drives, UL recognized power supplies and 8-slot OSI 48 BUS backplane.

Ohio Scientific's new C2-OEM is designed to be the cost effective solution to business and industrial applications which can effectively utilize typical microcomputer execution speed. The C2-OEM benefits from Ohio Scientific's years of volume microcomputer production experience yielding an extremely competitively priced medium performance microcomputer.

The C2-OEM utilizes the popular 6502 microprocessor operated at 1MHz clock speed in conjunction with 48K or 450 NS Dynamic RAM memory.

This hardware configuration when used in conjunction with Ohio Scientific's ultra fast BASIC by Microsoft yields Business environment performance equal to or better than competitive microcomputer systems.

The C2-OEM is housed in a versatile table top cabinet which can also be rack mounted or incorporated in a matching desk which also accommodates a CRT terminal and printer.

The system features very simple physical construction and the use of industry standard parts for reliable operation and simple servicing. All circuitry is on two 8 x 10″ OSI BUS compatible PC cards, one for the 48K memory and the other which contains the CPU, Firmware, RS-232 port and floppy controller.

The cards are plugged into an 8 slot back plane which provides tremendous expansion capability. The unit features two industry standard 8″ Floppy disk drives and is powered by two standard UL recognized open frame power supplies.

The C2-OEM's low cost, simple construction, standard performance, and factory configuration make it the logical choice when a simple, rugged "no problems" computer is desired.

Features:

Simplest, most cost-effective computer when typical microcomputer execution speed is acceptable.

- Full business configuration standard • 48K dynamic RAM
- .35 MIPS 6502 CPU • RS-232 port at 300 to 19,200 baud
- Dual 8″ floppies store 600 Kbytes
- OSI BUS oriented for modular expansion
- Fast low overhead disk operating system standard
- Microsoft BASIC with random and sequential access files
- Instant load disk bootstrap and front panel emulator in ROM

Prices

C2-OEM	As specified above	$2799

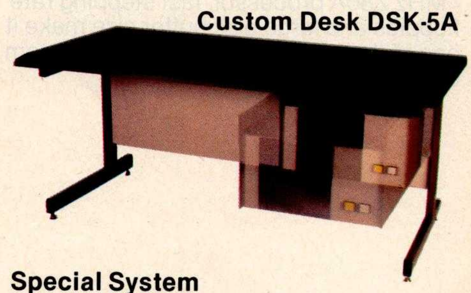
Options

-01	Double-sided disks doubles capacity to 1.2 Mbythes.	800
-02	Internal video board and keyboard with numeric pad provide complete terminal function with upper/lower case and graphics within the computer (a low cost alternative to conventional CRT terminals). Just add a TV monitor for a complete low cost system.	299
-03	Conversion to static RAM uses one more slot (2-24K boards) and adds 4.5 amps additional power.	600
-04	Double cases—uses separate cases for computer and floppies. Identical in appearance to the C3-S1.	200
-05	OS-AMCAP package provides AMCAP V1.5 and OS-65U at a $300 savings when purchased with the computer.	$875

Notable Accessories

AC-3P	12″ TV monitor for use with the 02 option	129
CA-17	Plug-in board adds intelligent terminal capability under Level 3 NET.	298
DSK-5A	5 foot matching desk with slide-in mounting for C2-OEM, C3-OEM or C2-NET.	300

Custom Desk DSK-5A



Special System

C2-NET	C2-OEM-04 with a CA-17 but without the floppy disk drives. Unit has special "down load" bootstrap ROM which loads the operating system from a network data base on power up. Just add on RS-232 terminal for the lowest cost intelligent terminal configuration.	$1499

Ohio Scientific Microcomputers for all reasons

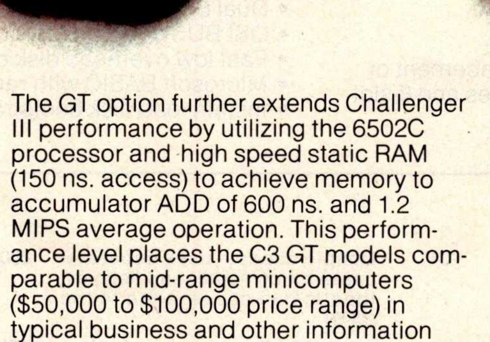
The Premium Performance C3 Series

The Challenger III family of computers is one of the most popular small computers in existence with tens of thousands of units installed to date. The C3 series provides several unique features including:

- 3 processors — the 6502A, 68B00 and Z80A
- User programmable interrupt vectors on all three processors
- OSI 48 line BUS architecture with 16 data lines and 20 address bits (1024K address space)
- Upward expandability to 74 megabyte disk drives
- Upward expandability to timeshare and distributed processing configurations
- Broadest line of plug compatible accessories in the industry
- Broadest line of systems and applications software of any small computer (three processors is unbeatable here)
- Fastest instruction execution speed commercially available in a microcomputer (with GT option)

The C3's Z80 supports Ohio Scientific's implementation of Digital Research's CP/M® operating system. This very popular operating system supports nearly a dozen upper level languages and hundreds of business, scientific and educational packages from several independent suppliers. The Challenger III's 4MHz Z80A processor, fast stepping rate floppies and large disk buffer size make it one of the fastest CP/M operating system compatible computers available.

CP/M's excellent performance is overshadowed by the C3's 6502A ultra-high performance processor which executes Ohio Scientific's OS-65D developmental operating system and OS-65U, a highly advanced business BASIC operating system with multi-user and distributed processing capabilities. The 6502A performs a memory to accumulator ADD in 1.0 μs. and a jump extended in 1.5 μs. with an overall average of .7 Million Instructions per Second (M.I.P.S.) making it far faster than any other widely used microprocessor (including the new 16-bit versions).



The GT option further extends Challenger III performance by utilizing the 6502C processor and high speed static RAM (150 ns. access) to achieve memory to accumulator ADD of 600 ns. and 1.2 MIPS average operation. This performance level places the C3 GT models comparable to mid-range minicomputers ($50,000 to $100,000 price range) in typical business and other information intensive applications. Such computers are much faster in arithmatic operations because of their wider wordwidth but this performance advantage is not cost effective in all but the most demanding number crunching applications.

Upward Expandability

Users can start with a relatively modest C3-OEM table-top computer and transport all of their software and most, if not all, of their hardware upward in simple plug-together expansion steps to hard disk storage, multi-programming — timesharing, distributed processing and finally, to an "office of the future" computer network.

Versatility

Ohio Scientific's plug-in options include the full scope of business accessories including a word processing printer, modem and matching furniture. Parallel I/O, A/D D/A capability, PROM blaster, clock and prototyping options satisfy the needs of the educator and OEM.

Voice I/O, the Universal Telephone Interface, AC remote control, wireless security systems, affordable ultra-fast execution speed, network capability and huge storage capacity challenge the most creative innovators to develop the applications of tomorrow.

The Challenger III Series



C3-S1



C3-OEM



C3-A

Family Features

Premium performance 3-processor computer systems.

- Full business configuration standard
- 3-processors 6502A, 68B00, Z80A
- 6502A operation at .7 MIPS standard
- Z80A operation 4MHz, 68B00 operation 2MHz
- 48K high speed static RAM standard
- 20 address bits with memory pager addresses 768K
- User programmable interrupt vectors
- 8-bit parallel I/O port
- Instant loading floppy disk bootstrap/hard disk bootstrap/front panel emulator in ROM
- RS-232 port strappable from 300 to 19,200 baud
- Dual 8″ floppies store 600K bytes
- OSI 48 line BUS oriented for modular expansion
- OS-65D fast low overhead development operating system with ultra-fast BASIC standard
- OS-65U advanced business operating system standard
- Largest accessory family in the microcomputer industry
- Largest software library in microcomputing (due to its unique 3-processor architecture)

C3-S1, C3-OEM

These two computers are table-top versions of the C3 system with a total of eight OSI BUS slots. They are ideally suited to applications which do not require hard disk drives and/or multiple users. Both systems can be enhanced by adding the GT option and/or dual-sided drives. They support OS-CP/M by expansion to 56K RAM and can be networked by expansion to 56K and a network I/O port. (The CA-17 provides network and CP/M compatibility.) The C3-OEM is a single-case table-top unit similar to the C2-OEM except for larger power supplies and can be mounted in the DSK-5A. The C3-S1 is in two cases which can be shipped via U.P.S. (the C3-OEM must be shipped by freight). The C3-S1's floppies can be independently turned off; a useful feature for process control and security applications.

Prices

C3-S1	As specified above with 48K	**$4095**
C3-OEM	As specified above with 48K	**3995**
-GT Option	Increases 6502 execution speed to 1.2 MIPS average (150 ns main memory)	**1500**

C3-A

The C3-A system is a 17-slot version of the C3 series in a stylish free-standing equipment rack. Although the standard machine has the same circuit boards and hence the same functional specifications as the C3-OEM or C3-S1, the system can be directly expanded to 8 users, hard disk operation and a network data base node configuration by simple plug-in operations. The rack also accommodates the PDS-1 system power sequencer and Alloy Engineering cartridge tape back-up units.

The C3-A features rack slide-mounted CPU and floppies as well as removable side panels and locking back door for convenient servicing and upgrading.

Prices

C3-A	As specified above with 48K	**$5995**
-GT Option	Increases 6502 execution speed to 1.2 MIPS average (150 ns main memory) and adds heavy duty switching power supplies.	**1950**

C3 Family Options

-01	Double-sided drives, doubles capacity to 1.2 Mbytes	**$800**
-06	OS-AMCAP package provides AMCAP 1.5 at a $200 savings when purchased with the computer (65U is standard with C3's)	**775**
-07	CP/M package requires CM-10 or CA-17 for operation. Provides OS-CP/M, Z80 Assembler/Editor, Microsoft Z80 BASIC, FORTRAN and COBOL at a $250 savings over individual prices when purchased with the computer.	**400**
-08	Real time clock option	**100**

Ohio Scientific Microcomputers for all reasons

Winchester Technology Disks

Floppy disks store from 250K bytes to 500K bytes per surface in a series of concentric circles called tracks which each store 2.5K to 7K bytes. To access specific information a head must be mechanically positioned over the track, then the computer must wait for the information to rotate under the head. On an 8″ floppy accessing a specific piece of information this can take as long as 1.2 seconds even though the computer could have processed the informaion in a few microseconds. (The access time of mini-floppies is much worse.) Furthermore, in most business applications, it is impossible to store all necessary information on one floppy disk; thus requiring several diskettes and frequent disk changes.

The traditional solution to these problems is the conventional removable platter hard disk. These disks rotate ten times faster than floppies and use more elaborate head positioners to move from track to track as much as ten times faster than floppies. Hard disk storage ranges from a few megabytes to a few hundred megabytes.

There are several problems with conventional hard disks. First and foremost, the extremely high bit density on the disks makes them very sensitive to mechanical misadjustments and contamination such as vibrations, dust and temperature differences of a few degrees, etc. Attempts to use removable hard disks in any other than a big computer, air conditioned, clean room environment by other than experienced computer operators can result in expensive head crashes and the complete loss of a disk pack. The second problem with these drives is that since they require close mechanical tolerances for bit density, disk removability and interchangeability, they are very complex mechanical devices. This results in large physical size, high power requirements and, most of all, high initial cost and high maintenance cost.

Enter the Winchester:

In the mid-70's a new disk technology was developed which eliminates most of the undesirable features of hard disks for small computer users; the Winchester hard disk. Winchesters utilize fast rotating high density disks and medium to high speed head positioners to achieve performance comparable to the most expensive hard disks. However, to minimize mechanical complexity and difficulty of use, they use fixed or non-removable media. Because the media is factory installed, the critical head-disk tolerances can be maintained with relatively simple mechanics. The fixed nature of the drive allows the disk chamber to be sealed eliminating the possibility of contamination.

Most Winchesters simply have an on-off switch making them even simpler than floppies to use from an operator viewpoint. In high storage capacity models they achieve the lowest cost per bit of any Random Access Memory technology now available.

The Winchester disk solves all the problems of floppies and conventional hard disks but creates one big new one! Back Up. Ohio Scientific has effectively solved this problem with three approaches depending on the specific application, see the box below.

Ohio Scientific Winchesters

OSI pioneered the use of Winchesters with microcomputers in 1977. Since then, we have installed more units than anyone else and have developed the most sophisticated Winchester hardware and software products for microcomputer use.

Hardware

Ohio Scientific offers two Winchester disks; the CD-23 and CD-74 (see next page) although they use different disk drives, the basic architecture is the same. Both units use a dedicated but programmable hard disk controller which receives commands from the host processor and then performs disk transfers independent of the processor. Data transfers are to and from a large dual port memory buffer. The dual port architecture and stand alone disk controller mean that virtually no processor overhead is required for disk transfers and that all segments of disk transfers are fully interruptable. Thus, disk operation does not degrade terminal interrupt response time in multi-user systems, a very important feature.

Software

OS-65U business operating systems and OS-DMS information management systems were designed from the "ground up" for use on Winchester based computers. Programs in 65U can directly access files up to 100 megabytes in length and directly support fast access techniques such as multi-key ISAM.

OS-DMS, information management system, provides a high degree of intelligence and end user versatility by its ability to utilize large disk files whereas most small business computers offer bare bones operation because of the need to pack information as tightly as possible on floppy disks.

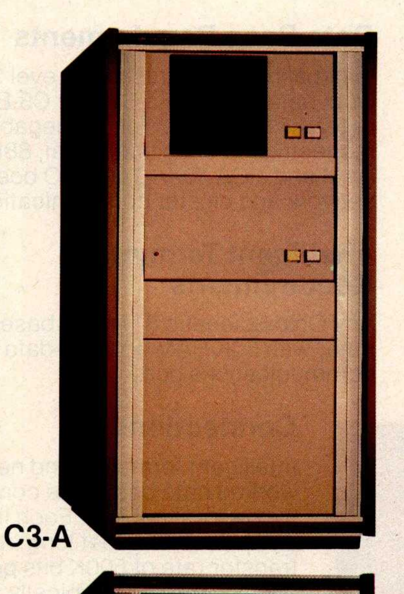
Ohio Scientific Winchester disk based computer offer business users a dramatic improvement in total performance over floppy based micro and minicomputers at a relatively modest cost.

You now have three backup options for use with the C3-B and C3-C Winchester disk based computers:

1. Fast floppy dumper under OS-HDM for small files (5 Mbytes or less). Daily to weekly backup.
2. 3M tape backup unit from Alloy Engineering. About 11 Mbytes per tape, cost about $3500. For medium files (Under 11 Mbytes). Weekly backup.
3. Networked C3-B's and/or C3-C's. Ultrafast backup of files up to disk capacity for Large files (over 11 Mbytes) and/or frequent backup requirements.

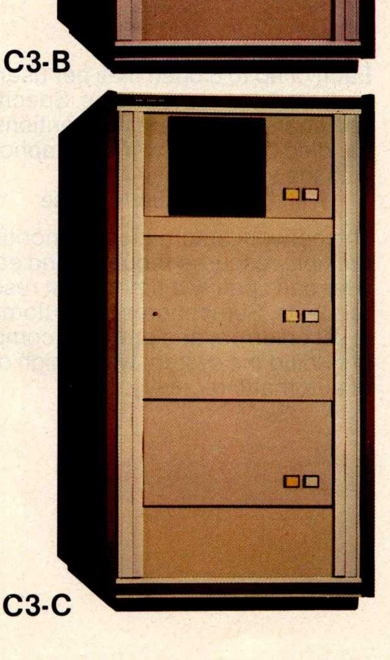
(Prices and specs subject to change without notice)

Hard Disk Computers



C3-A

C3-B



C3-C

Family Features

All standard C3 features including:

- 3-processor CPU
- .7 MIPS 6502A
- 48K static RAM
- Dual 8″ floppies
- Free standing rack for direct expansion capabilities
- 17-slot OSI 48 line BUS architecture for large system expansion
- Directly accepts up to 8 users with currently available memory boards, more with higher density boards in the future
- Directly expandable for use as Network data bases
- Slide-mounted subassemblies, removable side panels and locking rear door for easy expansions and service

C3-A

The floppy only rack based C3 for users who anticipate expansion to hard disk, multi-user and/or networking in the future. Additional specs are on the preceding pages.

C3-A	**$5995**
CD-74 expands C3-A to C3-B	**7500**
CD-23 expands C3-A to C3-C	**4500**
CA-16 heavy duty cooling pack (specify B or C)	**150**

C3-B

The world's most powerful microcomputer (when GT equipped). Features the highly advanced and extensively field proven OKIDATA 3306 Winchester disk. Some 3306 drives have operated since 1977 without a single failure.

Features

- System boots from floppies or hard disk on power up
- 74 megabytes end user workspace under OS-65U, 80 megabytes unformatted
- Ultra-high performance disk

  74 millisec worst case access
  38 millisec average

  10 millisec access on cylinder (215K user workspace)
  8 megabits per second transfer rate
- Simple on/off disk operation with elaborate internal protection from improper temperature, line voltage and controller failures
- Features spindle brake and designated head landing areas for much longer operational life than the newer low-cost Winchesters
- Highly advanced OS-65U operating system:

  Multiple level pass word security

  Multiple operating systems on disk

  Ultra-high speed "FIND" command for high speed string searches (Associative Access)

  Upward compatible with multi-user and network systems with full file, peripheral and communications arbitration between users
- Expandable to CP/M operation by adding 4K (CM-2 memory)
- Available factory configured for up to 8 users and network data base operation
- Comes standard with real time clock and heavy duty cooling package

C3-B	**$12,995**
GT Option (as per C3-A) add	**1,950**

C3-C

A medium performance Winchester disk based system which provides the ideal cost/performance ratio in typical small business applications. The C3-C uses the Shugart SA4008 29 megabyte Winchester disk.

Performance specifications, hardware configuration and software is identical to the C3-B with the following exceptions:

- 23 megabytes of end user workspace under OS-65U
- 29 megabytes unformatted capacity
- Medium performance Winchester

  240 millisec worst case access

  87 millisec average access

  10 millisec access on cylinder (110K user workspace)
- Simple on/off disk operation

C3-C	**$9,995**
GT Option (as per C3-A) add	**1,950**

Ohio Scientific Microcomputers for all reasons

Multiple User Systems

In applications where several terminals are desired, but most of which will be utilized for entry and editing (such as order entry systems), multiple user microcomputers are feasible. In environments where it is commonplace for more than one user to be processing information at a time, a single microcomputer may become annoyingly slow. A better configuration for such applications is distributed processing as discussed later.

All C3 series computers will support up to 16 timeshare users under OS-65U Level 3 providing that the computer has a real time clock, sufficient memory and the appropriate communications ports.

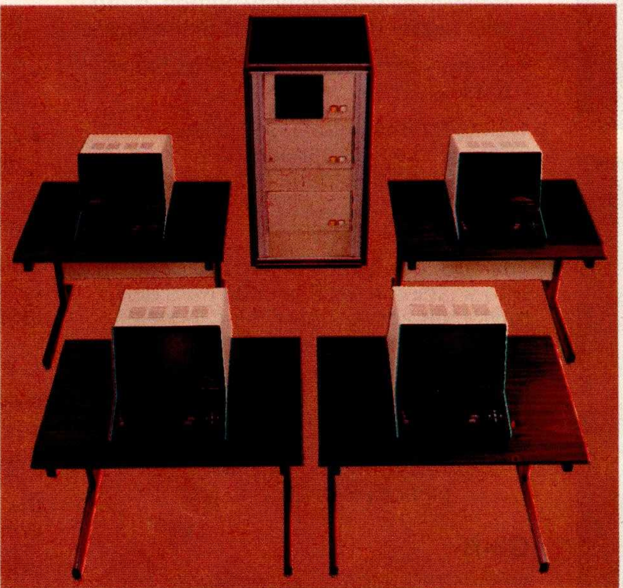
C3 computers utilize bank switching for multiple users. Each user must have 32K to 48K RAM and an RS-232 port. The host machine must also have 4K RAM for the multi-tasking executive. The computer timeshares individuals by interrupting a user after a set time (approximately 100 milliseconds) and bank switches to the next user in a "round robin" fashion. Bank switching architecture is not as memory efficient as techniques which use re-entrant code or swapping disks but is by far the fastest technique, requiring only a few microseconds of processor overhead per switch, a feature which is most important in multiple user systems.

Although OS-65U Level 3 will support timesharing on any C3, it is only recommended on C3-B and C3-C computers. This is because of the desirability of 17 BUS slots for multiple user memory partitions and the dramatic performance advantages of Winchester disks over floppies.

Networking

In a distributed processing system using OSI microcomputers as intelligent terminals (local systems) most of the work load is handled locally. Overall system performance does not degrade under heavy job loads. Each local system performs entry, editing and execution while utilizing a central data base for disk storage, printer output, and other shared resources.

For more demanding applications it is desirable to have several data bases, each with its own collection of local systems. Such an inter-connected set of data bases is called a network. Each data base and its local intelligent and dumb terminals is called a cluster.



Level 3 NET

OS-65U Level 3 NET supports this advanced networking and distributed processing capability as well as conventional single user operation and timesharing. Level 3 NET supports local clusters of intelligent microcomputer systems as well as dumb terminals for the purpose of utilizing a central Winchester disk data base and other shared resources. The system also has full communications capability with other Level 3 data bases providing full network capability.

Level 3 resides in each network data base. A subset system resides in each intelligent terminal. Each data base supports up to 16 intelligent systems and up to 16 dumb terminals. Level 3 also supports a real time clock, printer management, and other shared peripherals.

Data Base Requirements

Minimal requirements for a Level 3 network data base are a C3-C or C3-B computer system with 23 or 74 megabytes respectively, console terminal, 88K bytes RAM and a CA-10X 16 port I/O board for network and cluster communications.

Intelligent Terminal Requirements

Any Ohio Scientific 8″ floppy based computer with 56K RAM and one data base communications port.

Connections

Intelligent terminals and networked data bases are connected by low-cost cabling. Each link can be up to 10,000 feet long at a transfer rate of 500K bits per second, and will cost typically 30¢ a foot (plus installation).

Syntax

Existing OS-65U based software can be directly installed on the network with only one statement change! Level 3 has the most elegantly simple programming syntax ever offered on a computer network.

File syntax is as follows:

DEV A,B, C,D	Local Floppies	unchanged from single user and timeshare system
DEV E	Local Hard disks	
DEV K-Z	Specific network Data Bases	

Each of up to 8 open files per user can be from 8 separate origins. Specific file and shared peripheral contentions are handled by 256 network semaphores with the syntax Waite N
Waite N, close

The network automatically prioritizes multiple resource requests and each user can specify a timeout on resource requests. Semaphores are automatically reset on errors and program completion providing the system with a high degree of automatic recovery.

One Step at a Time

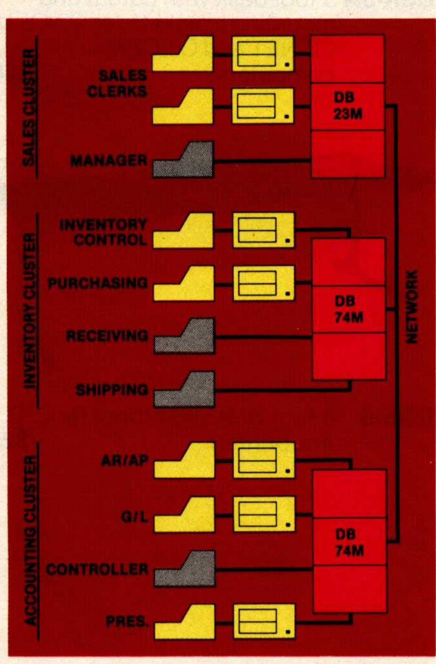
Best of all, Ohio Scientific users can develop distributed processing systems economically one step at a time. A user can start with a single user floppy system, add a hard disk, then timesharing, then a second Winchester data base for backup and, finally, cluster intelligent terminals to achieve a full network configuration.

Level 3 Support Group Factory Configured Systems

Prices include OS-65U Level 1 but do not include 65U Level 3 or Level 3 NET. Machines with NET prefix have the specified number of users plus NETWORK data base node capability. The NETWORK partition can be used as an extra user through its diagnostic RS-232 port.

For example, a 4-user system with networking can be used as a 5-user system without networking.

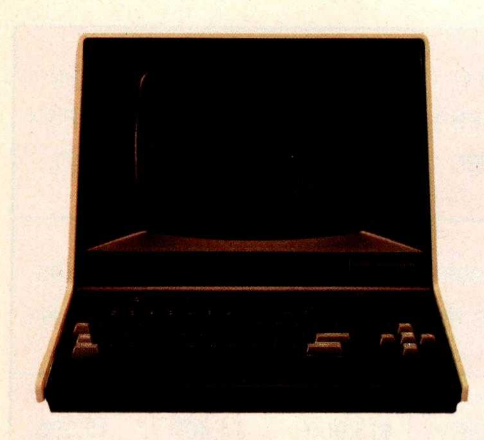
Network systems have ports for 4 intelligent terminals (cluster ports) and 1 NET port.



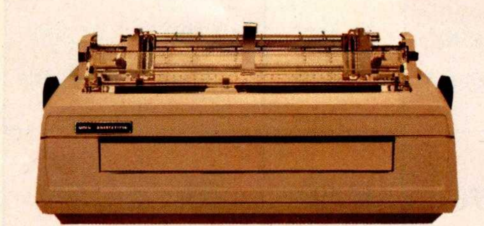
Time-share Users	C3-C .35 MIPS	C3-C .7 MIPS	C3-C .7 MIPS + NET	C3-B .35 MIPS	C3-B .7 MIPS	C3-B .7 MIPS + NET
1	NA	$9995 C3-C	$11,995 C3-C-N1	NA	$12,995 C3-B	$14,995 C3-B-N1
2	$10,900 C3-C-12	11,400 C3-C-22	12,995 C3-C-N2	$13,900 C3-B-12	14,400 C3-B-22	15,995 C3-B-N2
3	11,700 C3C-13	12,400 C3-C-33	13,995 C3-C-N3	14,700 C3-B-13	15,400 C3-B-33	16,995 C3-B-N3
4	12,400 C3-C-14	13,400 C3-C-44	15,200[1] C3-C-N4	15,400 C3-B-14	16,400 C3-B-44	18,200[1] C3-B-N4
5	13,100 C3-C-15	NA	NA	16,100 C3-B-15	NA	NA
6	13,800 C3-C-16	NA	NA	16,800 C3-B-16	NA	NA
7	14,500 C3-C-17	NA	NA	17,500 C3-B-17	NA	NA
8	15,200 C3-C-18	NA	NA	18,200 C3-B-18	NA	NA

Note 1. Uses 16-slots, 1 open, comes with printer and word processing ports installed.

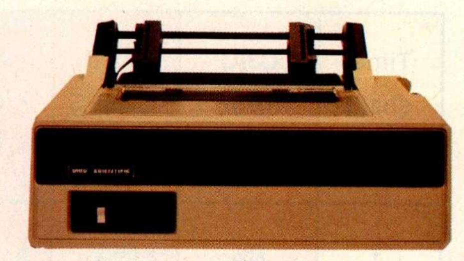
Ohio Scientific Accessories for all reasons



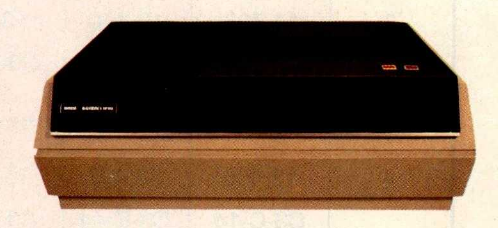
AC-7B
CRT terminal for use on all OSI single and multi-user systems. Features upper/lower case 24x80 character display, numeric keypad, dual intensity, protected fields, cursor addressing and much more. **$995**



AC-14
High performance word processing printer. Produces typewriter quality output at up to 55 characters per second. Features quick-change ribbon cartridges and drop-in print wheels for interchangeable fonts. Prints up to 132 columns, comes with friction-feed capability for stationary and adjustable width tractor-feed for computer forms. Complete with paper guides and silencer options. Produces proportional spaced characters when used with WP-2 word processor package. Comes complete with high speed parallel interface, cable and one print wheel. **$2795**



AC-9TP
A rugged moderate performance business printer. Impact printing at 110 characters per second, prints 80 or 132 columns across the page, has adjustable width tractors and forms stacker. Comes complete with parallel interface and connecting cable. **$1250**



AC-5A
Deluxe business printer. This "Top of the line" shuttle printer very quietly prints an entire line at a time using dot matrix impact technology. The unit prints 160 lines per minute at a 132 character column width. Features upper and lower case, 12 *programmable* fonts, 11 program selectable form lengths and much more. Comes complete with adjustable width tractor-feed, high speed parallel interface and cable. **$2950**



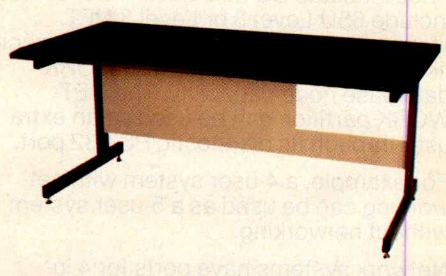
AC-11P
300 baud modem for use with conventional telephone handsets.
Features unique originate/answer back capability which allows two similarly equipped computers to talk to each other as well as communicating with timeshare services. Requires an RS-232 port for operation. **$199**



OSI Desks

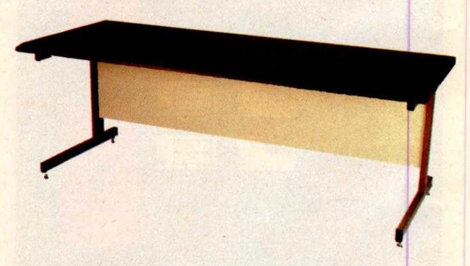
DSK-3 3 foot wide CRT and printer stand. **$175**

DSK-4 4 foot wide desk. **$215**



DSK-5 5 foot wide desk. **$250**

DSK-5A 5 foot desk with cutout and mounting brackets for C2-OEM, C2-NET and C3-OEM computers. **$300**



DSK-6 6 foot wide desk (best for CRT and printer). **$285**

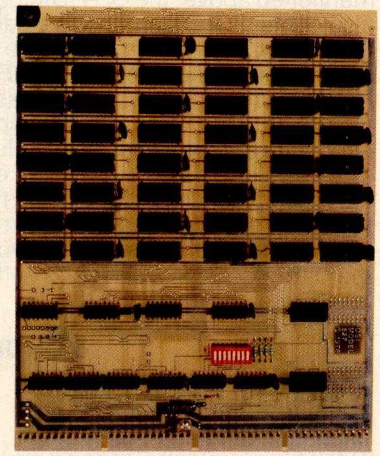
Microcomputer Components

OSI Power Sequencers Turn Entire Systems On/Off From One Keyswitch.

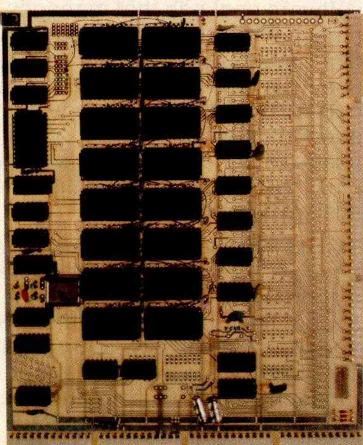
PDS-1 Switch panel for C3-A, B, C. Sequences CPU, floppies, hard disk, CRTs, printer and other accessories. **$350**

PDS-3 Switch panel for DKS-5A desk. Sequences CPU, floppies, CRT, printer and other accessories. **$200**

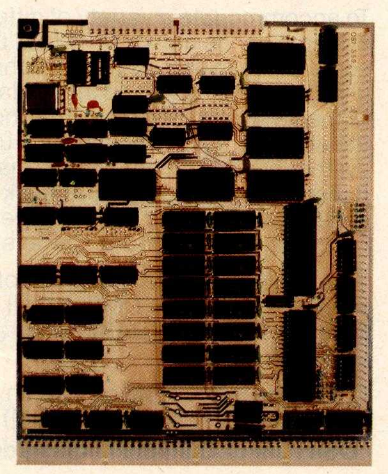
CM-9



CA-10-16



CA-18A



Memories

CM-2 4K 2MHz static for expanding C3-B, C3-C to 56K for CP/M and/or networking. **$129**

CM-3A 16K 2MHz low power static standard C3 memory. **$399**

CM-6 48K 1MHz dynamic for C2-OEM and some timeshare systems. **$549**

CM-9 24K 2MHz medium power statics usable in computer with booster supplies or high current switchers. **$450**

CM-10 8K 2MHz static for expanding C2 and C3 computers to networking or CP/M. (C3 only) **$198**

General I/O

CA-9 Centronics parallel printer interface with cable. **$175**

CA-10X 1 to 16 RS-232 port I/O board. 300-19200 baud plus synchronous operation at 250K and 500K baud. 1 port standard. **$125**

Each additional port. **$ 50**

CA-10-N5 CA-10X port board configured for four cluster communications ports and one network communications port all at 500K baud for use in data bases. **$349**

Combinational I/O

CA-17 8K 2MHz RAM and 1 cluster port plus 1 auxiliary RS-232 port. (Converts any C2 or C3 to networking.) **$298**

CA-18 1 Centronics parallel printer port with cable, 1 parallel word processing printer port with cable, 2 RS-232 ports and 1 cluster port. **$398**

CA-18A As above with 8K 2MHz RAM and 2 additional RS-232 ports (4 total), i.e., fully populated 555. **$598**

See the OEM and R/D section for more accessory boards.

Ohio Scientific Software for all reasons

OS-AMCAP (Level 1.5)

OS-AMCAP is a fully integrated small business accounting system. The software package runs on any Ohio Scientific dual-floppy, double-sided dual-floppy or hard disk based 6502 system with at least 48K RAM. OS-AMCAP contains the following integrated modules using a common data base:

General Ledger, including a complete user defined chart of accounts, cash receipts, cash receipts journal, cash disbursements, cash disbursements journal, journal entries, editing, balance sheet, trial balance and statement of earnings with complete editing for all of the above.

Accounts Receivable with and without aging, aged monthly statements.

Accounts Payable with and without aging.

Inventory, including inventory analysis, inventory by vendor, inventory overdue, inventory on order, inventory re-order, and detailed reports.

Billing/Invoicing and order entry for the inventory which will optionally support customer files with bill to, ship to, credit and customer mailing and monthly statements.

Payroll

For easy installation, the AMCAP system includes the AMCAP configuration program which automatically creates all necessary disk files based on the user's requirements. An AMCAP training disk which is pre-loaded with information for a hypothetical company is also included for demonstration and training purposes. A 250-page AMCAP Level II manual is included that describes Levels 1.5 and II.

OS-AMCAP is designated by Ohio Scientific to be a small concise easy-to-use "turnkey" business software package. OS-AMCAP has been in use at hundreds of locations for over two years.

OS-AMCAP $975

OS-AMCAP Level II

OS-AMCAP Level II contains all of the features included in Level 1.5 in addition to many other significant and valuable expansions that are a direct result of many end user requests.

- Divisionalization and departmentalization in the general ledger, inventory and payroll and all accounting journals such as C/R, C/D, A/R, A/P, JE and aging reports, balance sheet and the statement of earnings.
- Multiple cash in bank accounts, multiple accounts receivable/payable accounts by division or department.
- Listing of general ledger journals by from-date-to-date.
- Enhanced order entry to include temporary inventory items, special discounts and special list price considerations in addition to credit memos and quotations.
- Enhanced payroll which allows for up to ten miscellaneous deductions and multi-state payroll withholding tax includes payroll 941 form, W2 forms and check registers plus an advanced employee file editor.
- Monthly statements contain inclusion of automatic overdue charges as a service charge on each statement which is ready for window envelope mailing.
- Preset IBM compatible system 32 and IBM system 34 forms for monthly statements, invoices and payroll checks that are available locally.
- OS-AMCAP Level II is available only as an upgrade to AMCAP Level 1.5.

AMCAP 1.5 to AMCAP II upgrade $995

(AMCAP is a trademark of American Intelligent Machines)

OS-HDM Hard Disk Manager

General

The Hard Disk Manager is an end user oriented software package designed to allow multiple independent systems to reside on the hard disk at the same time. Each system can contain over 150 program or file entries in its separate directory. Each system can be of any length from 600K bytes to several million bytes long.

Any AMCAP, DMS or other BASIC programs that operate under OS-65U can occupy any system area of any length within the Hard Disk Manager. Provisions are included to easily transfer an existing floppy based system to any system within the Hard Disk Manager.

Fast Floppy Dumper

With the Fast Floppy Dumper back-up feature a user can easily and conveniently back up on removable floppies any or all systems (programs and files) residing on the hard with the standard hardware.

It takes approximately 1.3 minutes for each 250K of memory to automatically be placed on a floppy diskette and the HDM automatically prompts when one floppy is full and another should be inserted.

Cartridge Tape Back-Up

As with the Fast Floppy Dumper feature mentioned above, the OS-HDM package also contains a Cartridge Tape Back-Up feature. While this Cartridge Tape Back-Up is somewhat slower than the Fast Floppy Dumper it does not necessitate the operator inserting another floppy each time one becomes filled unless the size of a system on the hard disk exceeds the limit of the large capacity cartridge tape medium (approximately 11 megabytes). As with the Fast Floppy Dumper, the Cartridge Tape Back-Up is self-identifying and easily used by inexperienced personnel.

OS-HDM $675

OS-TMUM Timesharing Multi-User Manager

TMUM is a sophisticated and advanced software package that manages the timesharing features available with hard disk based C3 computers and offers the user true large computer timesharing capability with Log-On, Log-Off features, account number tracking, connect time usage by account number and system plus many other inherent timesharing system characteristics.

TMUM is designated to be used either in-house or with auto-answer modems and is thoroughly secure with non-echoing account number entry, system name, and classified password protection. The TMUM package is capable of accommodating up to 16 users and one console user depending upon machine configuration.

To accommodate a variety of different systems on the hard disk TMUM utilizes some of the multiple system techniques used with and explained in the Hard Disk Manager (HDM) package. This includes the ability to automatically back up any system of any size onto floppy diskettes. It also includes the ability to back up systems on the hard disk with the cartridge tape hardware now available.

The TMUM package is capable of running OS-AMCAP, DMS and all other programs including BASIC programs written in OS-65U.

OS-TMUM is available only as an upgrade to the Hard Disk Manager (HDM).

OS-HDM to OS-TMUM upgrade $1095

OS-DMS

The OS-DMS Nucleus and supporting business packages make up an extremely powerful Data Base Management System and Inquiry System that lend themselves to a wide range of small business applications. Generally, any collection of information of primary importance to a business can be placed in this system. To clarify the application of OS-DMS an explanation is necessary of a Data Base Management System and an Inquiry System.

Fundamentally, a data base is a collection of data. The data can be any information that is of value to a person, business or agency using the system. The data may be as varied as real estate files, inventories, personnel files, or automotive sales. Typically, data is usually kept in filing cabinets, card files, desk drawers, etc. Information in these categories are prime targets for a data base management system.

The operator has the ability to access the information of the data base in a manner which makes the data useful. The user has the ability to enter, remove, or edit information in the files to keep it current with present activities. The user also may change the order of information in a file to suit a particular application.

When the operator needs information, or a decision based on information in the file, a report of some kind will be generated.

The user, in some cases, may set specific conditions related to the report. Examples of conditions are inventory items over a certain amount, age analysis of accounts receivable or payable, or houses costing between two dollar amounts.

The emergence of OS-DMS makes computers immediately usable for the untrained small businessman. The system finally brings the use of microcomputers down to the level of non-programmers. It means that virtually untrained computer users can take advantage of the speed and efficiency of a computer in their daily activities.

OS-DMS Modules

OS-DMS Nucleus

OS-DMS Nucleus — provides the data base manager and information management system for DMS compatible files. Can be used to "computerize" any collection of information. Since it is written primarily in BASIC it can be easily customized for specific applications. It is also a useful maintenance tool to complement other DMS modules. **$300**

DMS modules—specialized applications packages based on the OS-DMS information management system.

OS-DMS — Inventory I and II

Inventory I is designed to be primarily a finished goods inventory for manufacturers, wholesalers and retailers. The system incorporates an inventory file, an order entry system, receiving program and shipping program. **$300**

Inventory II is primarily a manufacturing inventory system which can be integrated with Purchasing system and Bills of Material system. These three packages collectively provide small manufacturing businesses with capabilities comparable to those found in MRP system, but with a higher degree of personal control. The Inventory system maintains an inventory with average weekly usage, weeks on hand, weeks on order with a shipping and receiving (or stock room control) program. **$300**

OS-DMS Purchasing System

The Purchasing System complements Inventory II by maintaining a file of open purchase orders and deliveries against those purchase orders. **$300**

OS-DMS Bills of Material

The Bills of Material System interfaces with Inventory II and the Purchasing System and will provide bills of material for several levels of subassemblies. This program maintains bills of material with cost accounting and allows the user to break down any assembly to its subsequent subassemblies, and ultimately to raw parts. This inventory explosion is highly useful for forecasting raw parts usage based on finished goods sales. It can also be used for inventory control applications to update raw parts and subassemblies inventories by the subassemblies and finished goods shipped out of a department. **$300**

OS-DMS A/R, A/P

Accounts Receivable and Accounts Payable system maintains accounts receivable and payables aging, detailed reports and customer statements. **$300**

OS-DMS General Ledger

DMS General Ledger System maintains a detailed general ledger based on a user specified chart of accounts. Also produces monthly statements including balance sheet and profit and loss statements. **$300**

OS-DMS Personnel Payroll

The Personnel Payroll system provides payrolls for a several hundred employee company including check generation and quarterly reports. The Personnel Payroll system maintains detailed personnel files for each employee. It contains general purpose report writing capabilities which can generate a broad range of management requested reports. **$300**

OS-DMS Query

The Query System allows the computer operator to make queries about data stored in DMS compatible data bases. The result of this inquiry can be a simple answer or the generation of a report. Additionally the Query system allows end users to specify fairly complex report formats and store these report formats under user assigned names so that they can be recalled quickly for future use. DMS Query system effectively allows high-level utilization of the computer's resources by non-programmers. **$300**

OS-DMS Quotation Estimation

The Quotation Estimation package is useful for providing quotations and estimations on tasks which are comprised of many well defined and often used sub-tasks and components, such as those found in the construction industry. **$300**

OS-DMS Educational System

DMS Educational system allows teachers to generate drills, quizzes and tests without programming. The system allows several forms of student interaction. Grades and responses can be stored for teacher examination. Grades for an entire period can be automatically tabulated. **$300**

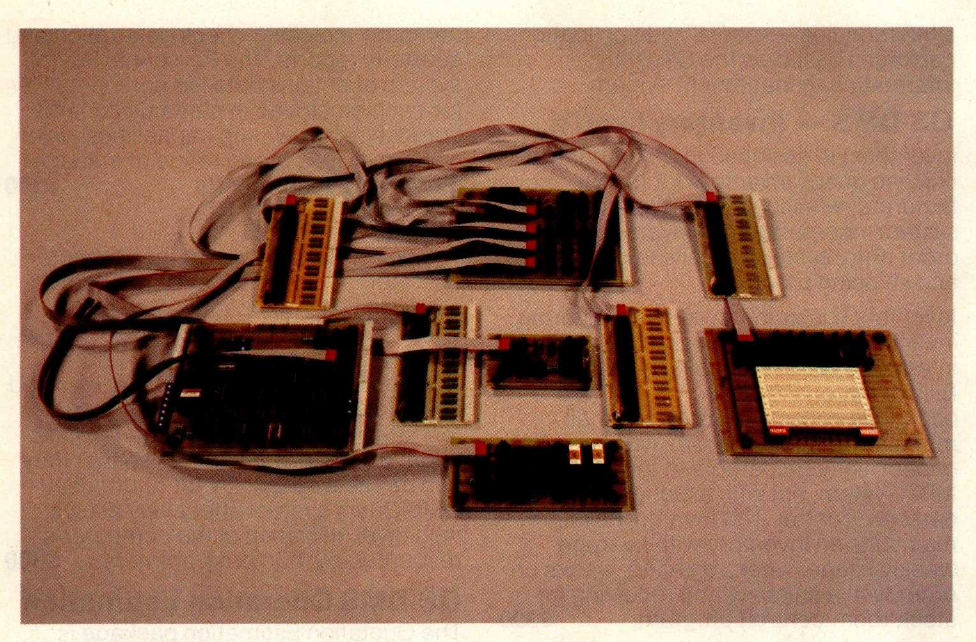
Customized Fully Integrated Systems

Customized fully integrated systems in the area of accounting, manufacturing, wholesaling, retailing and other services are available for multi-user timeshare and distributed processing based Ohio Scientific computer systems. These services are available through your local dealer as well as through the company's **Level 3 Support Group.** Contact your dealer for details.

Specialty Applications

Dozens of specialized applications have been generated by Ohio Scientific dealers and systems houses under OS-DMS including fully integrated Construction packages, Medical Billing systems, Legal Billing systems and a broad range of specialized information systems. Contact your dealer for the latest information concerning your specific application.

Ohio Scientific Accessories for all reasons



Ohio Scientific's Revolutionary New 16 Pin I/O BUS

Modern technology has made it possible to pack far more I/O functions on a computer board than one can practically connect to. Ohio Scientific has solved this problem with a series of remote "head end cards" which feature tremendous I/O capability and connect to the computer via single inexpensive 16 pin DIP ribbon cables. Thus I/O connection can be made away from the computer's card cage.

CA-20
8-port I/O BUS interface and calendar clock provides interfaces for 8 head end cards and a battery back up clock with hours, minutes, seconds, 1/10 second, day, and date. The automatically recharged batteries will power the clock for months. **$175**

CA-20A
As above without clock **$95**

Head End Cards

CA-21
48 Line Parallel I/O card features 3 PIA's and prototyping area **$45**

CA-22
High speed analog I/O module. Two 12-bit D/A converters, 1 12-bit/8-bit A/D converter with 16 channel input multiplexer. Factory configured for ± 10V offset binary, user jumperable for other configurations. Max error ± 2 LSB. 28,000 12-bit conversions per second. 66,000 8-bit conversions per second, drift. -50 ppm per °C. Note, the CA-22 can also be directly plugged into the computer without a CA-20, thus occupying one slot. **$598**

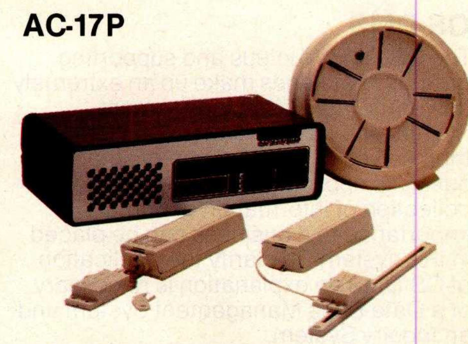
CA-23
PROM Blaster. Programs 2758, 2716, 2732 and 2764. 8 through 65K EPROMS. Programs and verifys from memory or other EPROM. **$195**

CA-24
Solderless interface prototyping board features a PIA and TTL I/O as well as provisions for direct user connection of devices such as the 6850 ACIA. Board also features 16 switches and 16 LED's. Has a large solderless breadboard for prototyping or educational lab exercises. **$175**

CA-25
Security and AC remote interface connects the AC-17P home security system and AC-12P wireless remote control system to C2 and C3 computers. **$45**

> 16 pin BUS family boards should be powered by external means where possible, however, a few modules can be supported by the host computer's supply if necessary.

AC-17P



A home security system, that's wireless and includes a control console, a fire detector, two window protection devices and one door unit. Additional protection devices are commercially available. **$249**

AC-12P



Wireless AC remote control. AC Remote Control Starter Set includes control console and modules to operate two lamps and two appliances via remote control with home control software on disk. Additional appliance and lamp modules are commercially available. **$175**

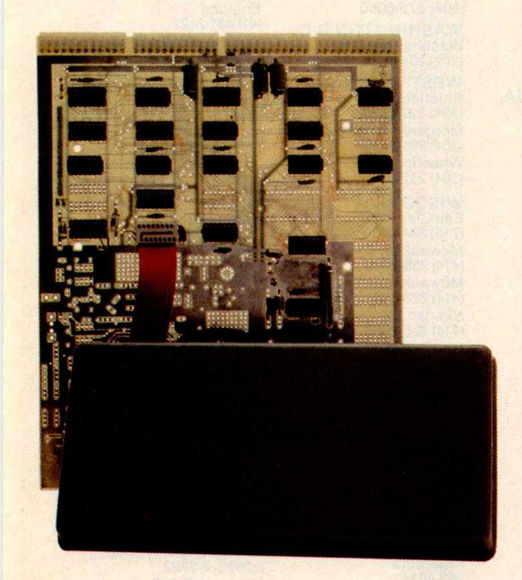
Process Control BASIC

A modified 9-digit BASIC under 65D with commands that support the real time clock, time of day clock (CA-20), 48 line parallel I/O (CA-21) analog I/O model (CA-22), AC remote (AC-12P) and to a limited extent the UTI (AC-15V) and security system (AC-17P). **$250**

Security BASIC — Use your computer for business accounting during the day and office and plant security at night!

A modified BASIC under 65D with commands which support the real time clock, AC-remote (AC-12P), security system (AC-17P) and universal telephone interface (AC-15V). Comes complete with a library of security program demonstrations. **$95**

OEM and R/D Accessories



CA-14A Votrax Voice I/O System

This Votrax Voice Synthesizer module has the capability of generating English speech phonetically. The supporting software simply feeds the phonetic spelling of English words to the module which generates medium quality spoken words. This advanced Votrax system is capable of generating all English phonemes as well as four levels of inflection on each phoneme. CA-14A also includes a voice recognition experimentation area which must be user populated. This experimentation board contains a five filter feature extractor with zero crossing detectors and envelope filters. The CA-14A in conjunction with the CA-22 high speed analog I/O module provide a complete voice recognition lab. **$399**



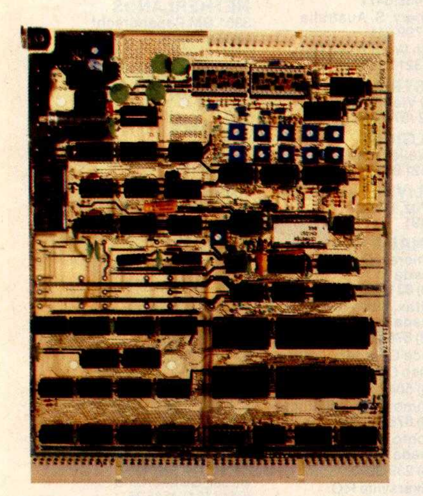
Voice Output Software

OS-Vocalizer I

"Generation by Rules System". Runs under OS-65D or OS-65U. Accepts conventional English spelling and outputs the phonetic spelling to the Votrax module in real time. Also, will print phonetic spellings for use by other programs. **$150**

OS-Vocalizer II

Runs in one partition of a 65U Level 3 system. Accepts normal print statements from other partitions (users) and vocalizes them in real time. Uses disk look up for the 3000 most common words and generation by rules for words not on file. End user can add approximately 1500 additional words to file. Generates the most legible speech now attainable via totally synthetic means (i.e. not recorded human speech). Operates on a C3-B or C3-C with at least two partitions. **$975**



CA-15 Universal Telephone Interface

The Universal Telephone Interface provides the host computer with general purpose telephone communications capability. The board can answer and originate calls. It can communicate with internal 300 baud modem in originate or answer back mode. It can also communicate with touch-tone and decode touch-tone. The board also has multiplexers to route spoken voice out to external devices such as recorders, voice recognition circuits, A/D converters and can accept spoken voice from several sources to dispatch to the telephone. The UTI can be used with touch-tone or rotary dial lines via its pulse code dialer. When equipped with a Votrax module or used in conjunction with a CA-14 voice I/O, it can respond with computer generated English voice output. The UTI is connected to telephone lines via a CBT. CBT's can be rented along with the telephone lines from your local telephone company or can be purchased from your local dealer and connected in parallel with your existing telephone circuitry. **$499**



UTI with Votrax CA-15B

The Universal Telephone Interface as above with Votrax Voice module allows your computer to generate English speech phonetically. It also includes an audio amplifier to allow the Votrax module to be used stand alone independently of the telephone lines. **$799**



CA-CBT

FCC approved telephone line isolator for use with the UTI. It allows the UTI to connect to any conventional telephone line. Note. CBT's can also be leased from your telephone company along with the telephone line. **$199**

See the next page for your nearest dealer.

Ohio Scientific Professional Systems Specialists

ALABAMA
Pelham, AL
(205) 663-1287

ALASKA
Anchorage, AK
(907) 344-8352

ARIZONA
Colorado City, AZ
(602) 875-2451
Tempe, AZ
(602) 966-6440
Tucson, AZ
(602) 294-8700

ARKANSAS
Fayetteville, AR
(501) 521-8637
Little Rock, AR
(501) 224-4508

CALIFORNIA
Anaheim, CA
(714) 991-3940
Anaheim, CA
(714) 995-0224
Beverly Hills, CA
(213) 858-0794
Brea, CA
(714) 990-3051
Costa Mesa, CA
(714) 540-5222
Fresno, CA
(209) 485-3340
(209) 299-8459
La Mesa, CA
(714) 465-8888
Monterey Park, CA
(213) 573-5991
Mountain View, CA
(415) 948-9595
Newbury Park, CA
(805) 498-6796
Oakland, CA
(415) 523-1923
San Diego, CA
(714) 272-8450
San Diego, CA
(714) 292-5302
San Leandro, CA
(415) 357-1737
Santa Monica, CA
(213) 396-3108
Tarzana, CA
(213) 449-2171
Tracy, CA
(209) 836-0928
Ukiah, CA
(707) 462-3470

COLORADO
Boulder, CO
(303) 444-3652
Boulder, CO
(303) 449-3725
Denver, CO
(303) 777-3222
Denver, CO
(303) 426-7743
Durango, CO
(303) 247-5905
Fort Collins, CO
(303) 491-5692
Montrose, CO
(303) 249-7736
Pueble, CO
(303) 542-8259

CONNECTICUT
Groton, CT
(203) 445-5166
New London, CT
(203) 447-1079
Wilton, CT
(203) 762-0717

FLORIDA
Ft. Lauderdale, FL
(305) 566-0776/566-0805
Ft. Lauderdale, FL
(305) 772-6391
Gainesville, FL
(904) 378-0192
Melbourne, FL
(305) 723-7880
Miami, FL
(305) 667-6119
Rockledge, FL
(305) 632-1090
Sarasota, FL
(813) 922-4257
Sarasota, FL
(813) 921-6444
Tampa, FL
(813) 876-6011

GEORGIA
Athens, GA
(404) 353-2858
Atlanta, GA
(404) 457-8540/451-7429
Savannah, GA
(912) 236-0498

HAWAII
Hilo,HI
(808) 935-2343
Honolulu, HI
(808) 732-5246/737-2372

ILLINOIS
Arlington Heights, IL
(312) 870-7400
Carbondale, IL
(618) 549-8495
Chicago, IL
(312) 463-0847
Crest Hill, IL
(815) 725-0749
Evanston, IL
(312) 328-2600
Medinah, IL
(312) 894-2583
Mundelein, IL
(312) 724-3690
Olympia Fields, IL
(815) 469-4775
Peoria Heights, IL
(309) 685-1555
Prairieview, IL
(312) 634-0076
Quincy, IL
(217) 223-8498
Rockford, IL
(815) 229-0200
Springfield, IL
(217) 523-9899

INDIANA
Columbus, IN
(812) 376-7770
Elkhart, IN
(219) 295-8181
Fort Wayne, IN
(219) 468-4369
Indianapolis, IN
(317) 359-7445
Laporte, IN
(219) 362-5812
South Bend, IN
(219) 277-4655

IOWA
Lake Park, IA
(712) 832-3616

KANSAS
Liberal, KS
(316) 624-1888
Wichita, KS
(316) 688-0852

KENTUCKY
Pikeville, KY
(606) 437-6528

LOUISIANA
New Iberia, LA
(318) 367-1416/1417
New Orleans, LA
(504) 482-4458
W. Monroe, LA
(318) 388-2312

MAINE
Portland, ME
(207) 773-1051

MARYLAND
Annapolis, MD
(301) 263-8449
Baltimore, MD
(301) 685-7313
College Park, MD
(301) 277-6828
Gaithersburg, MD
(301) 840-9540
Hagerstown, MD
(301) 739-6500
Wheaton, MD
(301) 933-6555/933-8770

MASSACHUSETTS
Cambridge, MA
(617) 661-2670
West Springfield, MA
(413) 733-6648

MICHIGAN
Berrien Springs, MI
(616) 429-3034
Burton, MI
(313) 742-3701
Detroit, MI
(313) 538-4222
Farmington Hills, MI
(313) 477-4470
Grand Rapids, MI
(616) 451-8348/451-8349
Midland, MI
(517) 631-6840
Muskegon, MI
(616) 722-3019
Richland, MI
(616) 629-9173
Saginaw, MI
(517) 753-9041
Troy, MI
(313) 362-4884

MINNESOTA
Bemidji, MN
(218) 751-4140
Bloomington, MN
(612) 884-6744
Duluth, MN
(218) 727-3578
Minneapolis, MN
(612) 588-3944
Minneapolis, MN
(612) 559-0320
St. Paul, MN
(612) 646-8441
Willmar, MN
(612) 235-5971

MISSISSIPPI
McComb, MS
(601) 684-1688
Michigan City, MS
(601) 224-6470

MISSOURI
Joplin, MO
(417) 782-1285
Lee's Summit, MO
(816) 524-5333
Manchester, MO
(314) 394-4545
Ozark, MO
(417) 485-2501
St. Louis, MO
(314) 962-0382
(800) 325-9494

MONTANA
Helena, MT
(406) 442-6665

NEBRASKA
Lincoln, NB
(402) 483-1989
Omaha, NB
(402) 592-3590

NEVADA
Las Vegas, NV
(702) 382-0562
Reno, NV
(702) 826-5055

NEW HAMPSHIRE
Union, NH
(603) 473-2323

NEW JERSEY
Bayonne, NJ
(201) 858-0115
Ft. Lee, NJ
(201) 461-2800
Lincroft, NJ
(201) 780-3857
Pompton Plains, NJ
(201) 835-7080
Westfield, NJ
(201) 232-0511

NEW MEXICO
Albuquerque, NM
(505) 266-8224
Albuquerque, NM
(505) 265-8007
Albuquerque, NM
(505) 256-9111

NEW YORK
Bronx, NY
(212) 231-2800
East Chester, NY
(914) 779-5292
East Williston, NY
(516) 746-1079
Farmingdale, NY
(516) 694-8222
New York, NY
(212) 279-9034
Potsdam, NY
(315) 265-5620
Rochester, NY
(716) 442-5861
Rochester, NY
(716) 325-5570
Wantagh, NY
(516) 785-4033
Williamsville, NY
(716) 631-3011

NORTH CAROLINA
Fayetteville, NC
(919) 485-2661
Lumberton, NC
(919) 739-5535
Raeford, NC
(919) 875-2798

OHIO
Akron, OH
(216) 253-3389
Alliance, OH
(216) 821-2600
Cleveland, OH
(216) 461-7650
Columbus, OH
(614) 866-1307
Columbus, OH
(614) 451-6400
Columbus, OH
(614) 436-8442
Dayton, OH
(513) 433-8484
Euclid, OH
(216) 289-6600
Lancaster, OH
(614) 687-0629
Medina, OH
(216) 725-4560
North Canton, OH
(216) 497-0847
Northfield, OH
(216) 467-0003
Toledo, OH
(419) 241-1393
(800) 472-0207
Warren, OH
(216) 392-7595

OKLAHOMA
Oklahoma City, OK
(405) 946-5492
Oklahoma City, OK
(405) 947-7896
Tulsa, OK
(918) 627-1064

OREGON
Corvallis, OR
(503) 754-0675
Marylhurst, OR
(503) 635-3544
Medford, OR
(503) 779-5612
Milwaukie, OR
(503) 654-9574

PENNSYLVANIA
Allentown, PA
(215) 820-0200
Chinchilla, PA
(717) 587-4771
Erie, PA
(814) 454-7652
Greensburg, PA
(412) 836-6502
Lewisberg, PA
(717) 524-0638/523-9684
Monroeville, PA
(412) 372-7701
New Brighton, PA
(412) 846-3000
New Kensington, PA
(412) 337-6080/335-9185
Philadelphia, PA
(215) 567-2111
Reno, PA
(814) 677-6502
State College, PA
(814) 237-6555
West Chester, PA
(215) 436-4750

SOUTH CAROLINA
Greenville, SC
(803) 244-8220
Hilton Head, SC
(803) 785-8393
Summerville, SC
(803) 873-8767
Sumter, SC
(803) 773-2526

SOUTH DAKOTA
Sioux Falls, SD
(605) 335-6464

TENNESSEE
Bristol, TN
(615) 968-1599
Chattanooga, TN
(615) 892-2411
Humboldt, TN
(901) 784-6810
Kingsport, TN
(615) 349-6172
Morristown, TN
(615) 581-4909
Oak Ridge, TN
(615) 482-9031

TEXAS
Bryan, TX
(713) 846-8268
Houston, TX
(713) 680-2664
League City, TX
(713) 332-5555
Odessa, TX
(915) 333-4516
Pharr, TX
(512) 685-4502/787-3208
San Antonio, TX
(512) 828-0553
Spring, TX
(713) 353-0518

UTAH
Hildale, UT
(801) 874-2338
Lehi, UT
(801) 768-3698
Provo, UT
(801) 374-9580
Salt Lake City, UT
(801) 262-7100
Salt Lake City, UT
(801) 486-7555

VIRGINIA
Arlington, VA
(703) 527-4600
Blacksburg, VA
(703) 953-2634
Charlottesville, VA
(804) 295-1975
Dry Fork, VA
(804) 432-8538
Newport, News, VA
(804) 874-7844
Norfolk, VA
(804) 461-0666
Richmond, VA
(804) 355-4361
Roanoke, VA
(703) 563-0693
Staunton, VA
(703) 886-5520
Staunton, VA
(703) 886-4098
Virginia Beach, VA
(804) 461-0330

WASHINGTON
Bellingham, WA
(206) 676-9558
Kent, WA
(206) 852-5400
Kirkland, WA
(206) 822-5300
Richland, WA
(509) 946-3330
Tacoma, WA
(206) 581-0388
Vancouver, WA
(206) 355-2220
Yakima, WA
(509) 575-6060

WASHINGTON D.C.
Washington, D.C.
(202) 234-6646

WEST VIRGINIA
Bluefield, WV
(304) 327-6583
Morgantown, WV
(304) 291-5400
Wheeling, WV
(304) 232-6837

WISCONSIN
Eau Claire, WI
(715) 834-8169
Milwaukee, WI
(414) 258-2588
Milwaukee, WI
(414) 228-8930
Neenah, WI
(414) 725-3020

WYOMING
Cheyenne, WY
(307) 632-9132
Cheyenne, WY
(307) 634-4956

ARGENTINA
Buenos Aires
Argentina
54-8589
Buenos Aires
Argentina
31-1385/2338
Buenos Aires
Argentina
762-4634

AUSTRALIA
Crows Nest, NSW
Australia
(02) 439-6477
Nethery, S. Australia
(08) 799-211
Perth West Australia
(09) 321-9232

AUSTRIA
1010 Vienna, Austria
0222 /57 95 91

BELGIUM
Bruxelles, Belgium
02/521-9580

BOLIVIA
La Paz, Bolivia
365191

CANADA
Bernieres, Quebec,
Canada
(418) 831-4522
Halifax, Nova Scotia,
Canada
(902) 876-2920
Prince George,
British Columbia
(604) 564-8298
Richmond, B.C. Canada
(206) 676-9558
Toronto, Ontario,
Canada
(416) 239-3913
Walkersville P.O.
Windsor, Ontario
(519) 254-1007

COSTA RICA
Heredia, Costa Rica
37-46-66

CYPRUS
Nicosia, Cyprus
(021) 76214

ECUADOR
Cuena, Ecuador
803-770
Quito, Ecuador
523-721

ENGLAND
Gants Hill,
Ilford, Essex, England
(01) 554-2177
Littleborough
Lancashire, England
(0706)79332
Chesham House
London, England
(01) 439-6288
New Barnett, London
England
(41) 441-2422
Northwich, Cheshire
England
(0606)75627
Kingston-upon-Thames
Surrey, England
(01) 549-9943

FRANCE
Paris, France
329-6327
Versailles, France
950-2820

FINLAND
Hamari, Finland
(15) 154647

GREECE
Athens, Greece
790-262

ICELAND
Reykjavik, Iceland
86620

IRELAND
Blackrock Co. of Dublin
Ireland
01-889825

ITALY
Milano, Italy
(02) 2363854

MEXICO
Mexico 6, D.F.
5-33-1180
Mexicali, B.C. Mexico
8-2629, 2-2222
Mexico, 21, D.F.
(905) 554-8300
Mexico, D.F.
556-6614

NETHERLANDS
3351 BM Papendrecht
Netherlands
079-156033

NEW ZEALAND
Auckland, New Zealand
664-149

PANAMA
Panama,
Republic of Panama
255292

PHILIPPINES
Legaspi Village, Makati
Metro Manila, Philippines
856411
Makati, Metro Manila
Philippines
87-30-81/87-81-21

PUERTO RICO
Hato Rey, Puerto Rico
(809) 751-4042

SCOTLAND
Glasgow, Scotland
041-634-3860

SWEDEN
Taby, Sweden
(08) 756-0155

SWITZERLAND
Basel, Switzerland
(0114161) 463626

TAIWAN
Taipei, Taiwan R.O.C. (10)
(02) 7819050, 7819035

TRINIDAD
Port of Spain
Trinidad and Tobago
62-38231

URUGUAY
Montevideo, Uruguay
90.48.12/98.78.61

VENEZUELA
Caracas, VZ
(02) 31.39.40
Maracaipo, VZ
7184
Caracas, VZ
72.38.93/71.92.75
Prados del Este
Caracas, VZ
979.77.42/979.98.08

WEST GERMANY
Hamburg, West Germany
040-33 09 35

Or for the name of your local dealer, call 1-800-321-6850 TOLL FREE.



1333 S. CHILLICOTHE RD • AURORA, OH 44202 • (216) 831-5600

Solve your personal energy crisis. Let VisiCalc™ Software do the work.

With a calculator, pencil and paper you can spend hours planning, projecting, writing, estimating, calculating, revising, erasing and recalculating as you work toward a decision.

Or with the Personal Software™ VisiCalc program and your Apple* II you can explore many more options with a fraction of the time and effort you've spent before.

VisiCalc is a new breed of problem-solving software. Unlike prepackaged software that forces you into a computerized straight jacket, VisiCalc adapts itself to any numerical problem you have. You enter numbers, alphabetic titles and formulas on your keyboard. VisiCalc organizes and displays this information on the screen. You don't have to spend your time programming.

Your energy is better spent using the results than getting them.

Say you're a business manager and want to project your annual sales. Using the calculator, pencil and paper method, you'd lay out 12 months across a sheet and fill in lines and columns of figures on products, outlets, salespeople, etc. You'd calculate by hand the subtotals and summary figures. Then you'd start revising, erasing and recalculating. With VisiCalc, you simply fill in the same figures on an electronic "sheet of paper" and let the computer do the work.

Once your first projection is complete, you're ready to use VisiCalc's unique, powerful recalculation feature. It lets you ask "What if?," examining new options and planning for contingencies. "What if" sales drop 20 percent in March? Just type in the sales figure. VisiCalc instantly updates all other figures affected by March sales.

Or say you're an engineer working on a design problem and are wondering "What if that oscillation were damped by another 10 percent?" Or you're working on your family's expenses and wonder "What will happen to our entertainment budget if the heating bill goes up 15 percent this winter?" VisiCalc responds instantly to show you all the consequences of any change.

Once you see VisiCalc in action, you'll think of many more uses for its power. Ask your dealer for a demonstration and discover how VisiCalc can help you in your professional work and personal life.

You might find that VisiCalc alone is reason enough to own a personal computer.

VisiCalc is available now for Apple II computers with versions for other personal computers coming soon. The Apple II version requires a 32k disk system.

For the name and address of your nearest VisiCalc dealer, call (408) 745-7841 or write to Personal Software, Inc., 592 Weddell Dr., Sunnyvale, CA 94086. If your favorite dealer doesn't already carry Personal Software products, ask him to give us a call.



VisiCalc was developed exclusively for Personal Software by Software Arts, Inc., Cambridge, Mass.

Circle 16 on inquiry card.

TM—VisiCalc is a trademark of Personal Software, Inc.

*Apple is a registered trademark of Apple Computer, Inc.

Add a Simple Text Editor to Your BASIC Programs

Robert G A Goff MD
Berkeley Medical Data
POB 5279
Berkeley CA 94705

While text editors are, in general, extremely useful for preparing all sorts of paperwork, it is usually not possible to append them to your own BASIC programs. This article is a simple tutorial in the bare essentials of text editing in BASIC. With these techniques, it will be possible for you to add simple text processing capability to any of your personal or business programs written in BASIC, which require paragraphed textual output. The program is written in North Star BASIC, version 6, release 3. It may be stored, as is, in 3186 bytes; it executes in a total of 4746 bytes. Deleting the remark statements reduces the program length to 1410 bytes enabling it to execute in 2956 bytes. While listing 1 is fairly self-explanatory, I'll discuss each of the steps in detail.

Text Editing

There are several tasks which text editors must accomplish. Most of these fall under the general category of producing a hard copy of text in an acceptable format. The barest definition of "an acceptable format" is one in which words are not randomly truncated at the end of a line of print. With this single requirement met, the text will be readable. But even this single text editing function requires that there be some ways to:

- Access the text string from memory or input.
- Determine line length to be printed.
- Distinguish between words and spaces.
- Alter what is to be printed on a given line based on the three criteria above.
- Link the sentences together in the proper order.

Such a text editor assumes that the user has made certain that each sentence is punctuated, and that each sentence string ends with the two trailing spaces needed to separate consecutive sentences.

A more useful text editor would also possess the following capabilities:

- Add missing periods at the end of sentences and recognize question and exclamation marks as adequate punctuation.
- Remove extraneous spaces at the beginning of each new typed line.
- Automatically add the two trailing spaces between sentences.
- Indent paragraphs when desired.
- Translate numeric data fetched from memory or input into the corresponding string characters for inclusion within a sentence.
- Allow input of line length for printing.

Text editors used solely for input and composition of text, such as Michael Shrayer's *"Electric Pencil,"* possess one other powerful set of characteristics: the ability to make radical modifications to the text after input and prior to printing. Because of this capability, this type of text editor does not need to compensate for the user's input errors noted above. As useful as full capability text editors are (I used *Electric Pencil* to compose the manuscript of this article) they are of no use within a BASIC program written for some other application, since most commercially available text editors are written in machine language.

Accessing Text

Text must be manipulated as strings of characters, whether letters, numbers, or symbols. In North Star BASIC, string variables may have names consisting of a letter, A thru Z, optionally followed by a number, 0 thru 9, allowing 260 unique string names. This number is quite enough for most applications, since if more than 260 strings are manipulated, several strings may be linked (concatenated), then renamed as a single string, and the variables thus freed reused

for new strings. Strings of over 10 characters must be dimensioned at the start of the program, and may have dimensions limited only by your computer's memory. A portion of a string may be accessed using North Star BASIC by appending to the string name the character positions of the first and last characters in the desired substring:

```
10 DIM A3$(8)
20 A3$="ABCDabcd"
30 PRINT A3$(3,6)
```

This causes the printing of "CDab." The BASIC line 30 PRINT A3$(5) causes the printing of "abcd."

In other versions of BASIC, substrings may be named differently. One such method (used in Microsoft BASIC) looks like this:

```
LEFT$(A$,3)   is the same as  A$(1,3)
MID$(A$,3,6)  is the same as  A$(3,6)
RIGHT$(A$,6)  is the same as  A$(6)
```

Strings may be stored in memory and accessed as individual variables. They may also be included in a data line of the program and read from there, or they may be entered during program execution.

Determining Line Length

Let us make L the number of characters to be printed per line. Now, any line to be printed will begin with character number B of the string and end with character number E. For the first line of print, B is set equal to 1 and E is set equal to L. To compute the range of the second line, set B equal to E+1 and E equal to E+L, and so forth, for the entire text. These line printing parameters are used to define the *line string* F$, by using B and E as the substring parameters. Thus, if the text string to be printed is E$, we set F$ equal to E$(B,E), and print F$. We increment B and E, then again set F$ equal to E$(B,E).

The one difficulty with this method occurs when any line of text to be printed is shorter than the line length. In setting F$ to E$(B,E), E will be greater than the length of E$, and will generate an out-of-bounds error. To prevent this situation, the length of E$ must be compared to the value of E using the function LEN(E$), which returns a number equal to the number of characters actually contained in the named string (E$). If E is greater than LEN(E$), the program lines which calculate and print F$ must be skipped; all that is left is to print E$(B), which will print from

Listing 1: *BASIC source program and a sample run of TXTEDIT2. This text editor is word oriented rather than line oriented. The normal editor, supplied with BASIC, works line by line in edit mode. This BASIC program allows changes of single words without having to retype an entire line. The program accepts four sentences of up to 97 characters each. A period is added to the end of each sentence if it is missing, as well as two trailing spaces. (The program recognizes the characters ? and ! as sufficient punctuation.) When printing the four sentences, the program removes any leading spaces at the beginning of a new line; line length may be adjusted by the user. The total number of characters entered plus any necessary punctuation and trailing spaces are calculated, changed into a string, and printed in the final sentence obtained by the program. The program is written in Release 3 of North Star BASIC. If you are using Release 4, delete the comma after PRINT #Z.*

```
220 REM *** #Z,=OUTPUT DEVICE (#1,=PRINTER, #0,=CRT)
230 INPUT#Z,'for printer, type 1, for CRT type 0 ',Z
240 IF Z=1 THEN FILL 51206,1\REM *** SET INPUT TO PRINTER
250 DIM A$(100),B$(100),C$(100),D$(100),E$(466),F$(466),G$(100)
260 INPUT#Z,'1st ',G$
270 GOSUB 800
280 A$=G$
290 INPUT#Z,'2nd ',G$
300 GOSUB 800
310 B$=G$
320 INPUT#Z,'3rd ',G$
330 GOSUB 800
340 C$=G$
350 INPUT#Z,'4th ',G$
360 GOSUB 800
370 D$=G$
380 PRINT#Z,'THE SENTENCES WITH PUNCTUATION,IF NEEDED, AND BLANKS'
390 PRINT#Z,'FOLLOWED IMMEDIATELY BY * TO SHOW SUBSTRING LENGTH'
400 PRINT#Z, A$,'*'
410 PRINT#Z, B$,'*'
420 PRINT#Z, C$,'*'
430 PRINT#Z, D$,'*'
440 PRINT#Z,\PRINT#Z,\PRINT#Z,
450 E$=A$+B$+C$+D$\REM ***CONCATENATE STRINGS INTO PARAGRAPH
460 I=LEN(E$)\REM *** 'I' WILL DEMONSTRATE DATA INSERTION
470 G$='Your sentences, with punctuation and spacing,'
480 G$=G$(1,45)+' total       characters.'
490 G$(52,55)=STR$(I)\REM *** CHANGE 'I' TO ITS STRING EQUIVALENT
500 REM *** AND INSERT IT INTO G$
510 E$=E$(1,I)+G$
520 D=1\REM *** START OF PRINT LINE
530 INPUT#Z,'Line length (number of characters)? ',L
540 E=L-4\REM *** L=LINE LENGTH
550 PRINT#Z,'THE CONCATENATED SENTENCES, PRINTED BY THE LINE'
560 PRINT#Z,\PRINT#Z,'     ',\REM *** INDENT PARAGRAPH
570 IF E>LEN(E$) THEN 670
580 F$=E$(D,E-1)\REM *** F$=LINE TO BE PRINTED
590 IF E$(D,D)=' ' THEN GOTO 760
600 IF E$(E,E)=' ' THEN 630\REM *** TEST FOR END OF WORD
610 E=E-1\REM *** SHORTEN LINE UNTIL END OF WORD IS FOUND
620 GOTO 580
630 PRINT#Z,F$
640 D=E\REM *** START OF NEXT LINE
650 E=E+L-1\REM *** SET LENGTH OF NEXT LINE
660 GOTO 570
670 IF E$(D,D)=' ' THEN GOSUB 760
680 PRINT#Z,E$(D)
690 PRINT#Z,\PRINT#Z,\PRINT#Z,
700 INPUT#Z,'Do you want to print this paragraph again? ',H$
710 IF H$(1,1)='Y' THEN 520
720 IF H$(1,1)='y' THEN 520
730 IF H$(1,1)='N' THEN END
740 IF H$(1,1)='n' THEN END
750 PRINT#Z,'YES or NO please'\GOTO 700
760 D=D+1
770 E=E+1
780 IF E$(D,D)=' ' THEN 760
790 GOTO 570
800 G=LEN(G$)
810 REM *** REMOVE TRAILING BLANKS
820 IF G$(G,G)=' ' THEN G=G-1 ELSE GOTO 860
830 REM *** RETURN TO CHECK FOR MORE TRAILING BLANKS
840 GOTO 820
850 REM *** CHECK FOR PUNCTUATION (ASCII .=46, !=33, ?=63)
860 IF(ASC(G$(G))=46 OR ASC(G$(G))=33) OR ASC(G$(G))=63 THEN 910
870 REM *** ADD PERIOD TO END OF SENTENCE
880 G$=G$(1,G)+'.'
890 G=G+1
900 REM *** ADD TRAILING SPACES
910 G$=G$(1,G)+'  '
920 RETURN
```

Listing 1 continued on page 36

Listing 1 continued:

```
RUN

for printer, type 1, for CRT type 0 1
1st The first sentence is properly punctuated.
2nd The second sentence is not punctuated
3rd What will the editor do with these 9 trailing spaces?
4th Such a quick job this makes of text material in your programs!
THE SENTENCES WITH PUNCTUATION,IF NEEDED, AND BLANKS
FOLLOWED IMMEDIATELY BY * TO SHOW SUBSTRING LENGTH
The first sentence is properly punctuated.  *
The second sentence is not punctuated.  *
What will the editor do with these 9 trailing spaces?  *
Such a quick job this makes of text material in your programs!  *


Line length (number of characters)? 72
THE CONCATENATED SENTENCES, PRINTED BY THE LINE

     The first sentence is properly punctuated.  The second sentence is
not punctuated.  What will the editor do with these 9 trailing spaces?
Such a quick job this makes of text material in your programs!  Your
sentences, with punctuation and spacing, total 203 characters.


Do you want to print this paragraph again? y
Line length (number of characters)? 13
THE CONCATENATED SENTENCES, PRINTED BY THE LINE

     The
first
sentence is
properly
punctuated.
The second
sentence is
not
punctuated.
What will
the editor
do with
these 9
trailing
spaces?
Such a quick
job this
makes of
text
material in
your
programs!
Your
sentences,
with
punctuation
and spacing,
total 203
characters.
```

character number B to the end of the string. *[This method also assumes that strings can have arbitrary lengths; Some BASIC interpreters limit strings to 256 characters in length . . .* **CH***]*

To indent a paragraph, initialize B to 6 and E to (L–5). Then, prior to printing the text, simply print five blanks, followed by a comma to keep the printing line open. The following program prints the entire string E$ in lines that are L characters long.

```
50 INPUT "What is line length?", L
60 B=6
70 E=L–5
80 IF E>LEN(E$) THEN 140
90 F$=E$(B,E)
100 PRINT F$
110 B=E+1
120 E=E+L
130 GOTO 80
140 PRINT E$(B)
```

Any words that cross the boundary between one printed line and the next would be arbitrarily broken to fit the line length, when using this program. To avoid this, it is necessary to scan the text for the last space before the end of each line to be printed, and shorten each line so that no partial word is left at the end. This is done by testing the first character following the proposed line of print. If it is a space, no word would be broken by printing the line as is. If on the other hand the first character following a proposed line of print is not a space, the end character of the print line must be either a space or an arbitrary character. So the print line is shortened by one character (E=E–1), and retested in the same way until a space is found as the next character following the proposed line of print. The line is then printed, and we go on to process the second line in a similar fashion. In the listing of TXTEDIT2, E is initially set equal to the line length plus one, and then, in line 600, character E of the proposed line of print is tested. If it is a space, E$(B,E–1) is printed. If not, the line is shortened by one character in line 610.

Linking Sentences

Strings that must be linked together, or concatenated, are placed in a string equation such as:

```
50 E$=A$+B$+C$
```

This will concatenate the strings in the order specified in the equation. With string variables, North Star BASIC does not allow many equation formats that would be perfectly acceptable if used for numeric variables. For example:

```
50 E$=E$+B$
```

will generate an out of bounds error, since the first E$ will be greater than the second E$. Because of this and other peculiarities of North Star BASIC string functions, intermediate variables must often be used to concatenate strings. (The example above will function properly in North Star BASIC Release 4.) As an example, if your program contains 11 strings that must be concatenated in a sequence determined by the program, you may either concatenate each of them by name (all in the same equation) or accumulate them one by one. If the latter method is chosen, an intermediate variable is necessary. If E$ is the paragraph to be printed, then:

```
50 F$=E$
60 E$=F$+A$
70 F$=E$
80 E$=F$+B$
90 F$=E$
```

with F$ being the intermediate variable, and A$ and B$ being new strings to accumulate in E$. F$ must be dimensioned equal to E$.

There is one other way of accumulating strings without obtaining an out-of-bounds error message: by specifying the length of the currently accumulated string and then concatenating literal text. That is:

```
50 G=LEN(G$)
60 G$=G$(1,G)+
    "This is the text to be added."
```

A peculiarity of North Star BASIC is that the statements:

```
50 G=LEN(G$)
60 G$=G$(1,G)+A$
```

will generate an out-of-bounds error message. Actually, the problem is that once a string has been defined, and in spite of its dimension, its length cannot be increased without redefining it in a concatenation equation that doesn't concatenate itself. Nevertheless, this rule can be violated when concatenating a string with itself and literal text. That is, the added string is presented in its entirety in the equation, enclosed within quotes.

Just as an aside, strings may be alphabetized by their first character by using the relationals > or <. Strings can be used in conjunction with LET, READ, DATA, INPUT, IF, and PRINT. In most versions of BASIC strings may be read from data intermingled with numeric variables as long as the proper sequence is maintained.

Inserting Numeric Data

Even though numeric values appear the same as number characters, they cannot be manipulated in the same way. A number cannot be inserted into a text string. First, it must be converted to its character equivalent. Then it may be inserted. This is understandable when you consider that, for example, in BASIC with 8 digit precision for numeric computations, a number (regardless of the number of digits) is stored in five bytes, whereas number characters within a string are stored as one byte (representing that particular print character) per digit.

This conversion is made by the STR$(expr) function, in which expr stands for the numeric value which must be converted into its string counterpart. In TXTEDIT2, this is used in line 490 to convert the numeric value of the length of E$ (represented by 'I' from line 460) into the equivalent string characters and insert them into the blank of string G$. The opposite conversion — from string number characters into a numeric value that can be manipulated algebraically — is performed by the function VAL(expr), with expr being the number characters of a string.

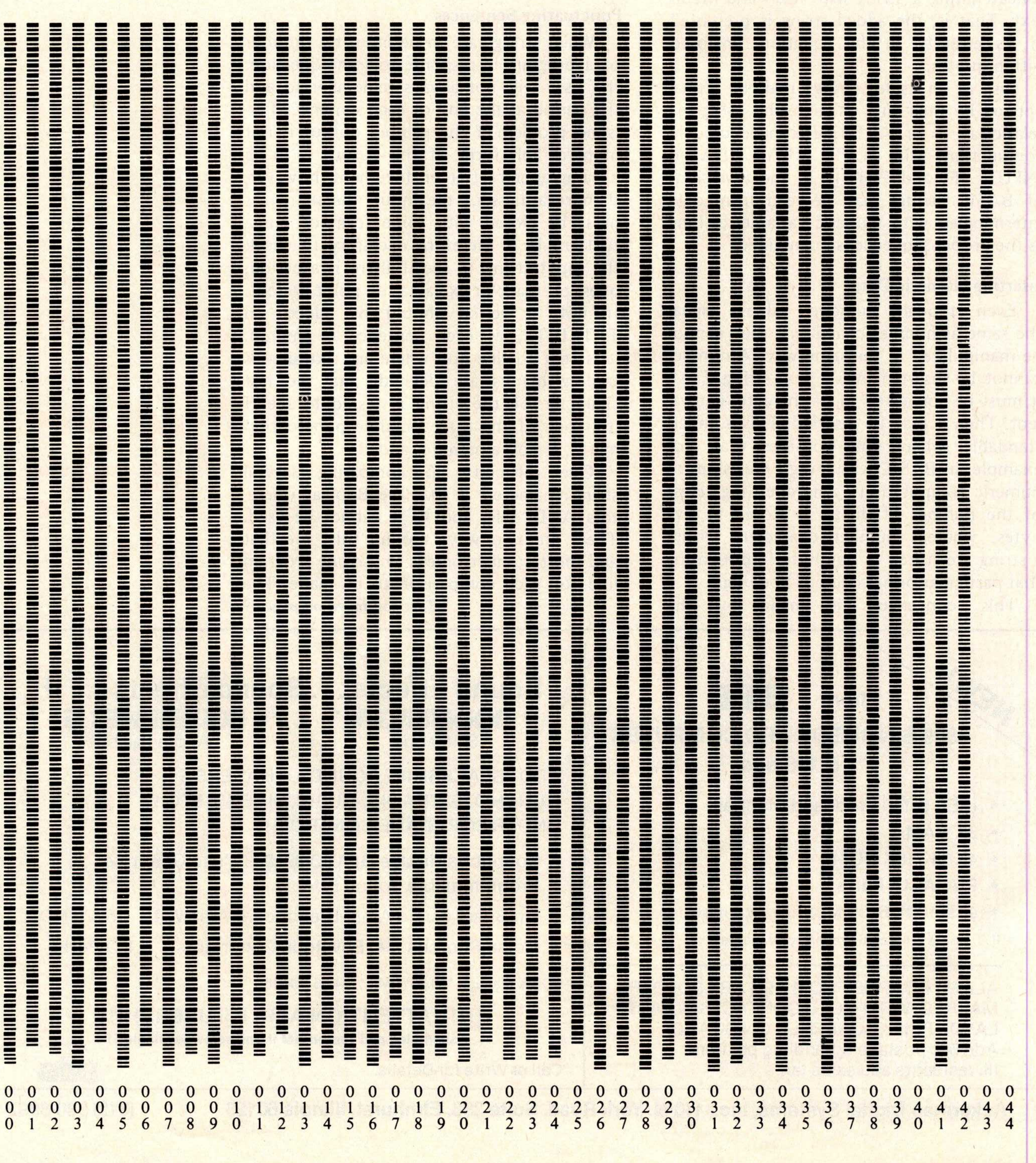
Punctuating Sentences

When strings are to be input by the user of a program in response to some question, the user will not always remember to add the period at the end of each sentence. This is no problem if the printed output is not in paragraph form. If the output is to be a paragraphed letter or document, however, then regardless of the input, the sentences must be closed with some form of punctuation. It is therefore necessary to check the input string to see if there is a period, question mark or exclamation point present. If not, a period should be added. In TXTEDIT2, as each sentence is entered, it is sent to line 800 where any extraneous trailing blanks are deleted, and the last character of the string is tested to see if it is one of the three possible punctuation marks. If not, a period is added.

One difficulty in comparing several string characters is that the Boolean operators AND, OR, and NOT cannot be used. There are two ways around this: the first and most cumbersome is to use one program line for each comparison to be made. The

Text continued on page 39

Figure 1: *Bar code representation of the shortened version of listing 1. In this version all the remarks and demonstration print statements have been removed to conserve memory. The bar codes represent textually coded data as described in the book* Bar Code Loader *(available for $2 plus $0.60 postage from BYTE Books, 70 Main St, Peterborough NH 03458, or from local computer stores).*



Text continued from page 37:

second is to convert the string characters into numbers that can be compared using the Boolean operators. Since VAL(expr) may be used only for string characters that represent numbers, it may not be used for converting alphabetic characters into numbers. Instead, the characters can be converted to the ASCII code decimal value by using the function ASC(string name), which will return the decimal ASCII value of the first character in the named string. This is demonstrated in lines 850 and 860 of TXTEDIT2.

Trailing Spaces

Sentences that are concatenated into a paragraph must be separated by two spaces. This is done by finding the last character of the string which is not a space, and then simply adding two spaces beyond that last character. This is done in line 910 of TXTEDIT2.

Leading Spaces

The last task for our text editor is to make certain that no line of print begins with a space. If the preceding sentence ends exactly at the end of the last print line, the next two characters to be printed will be the trailing spaces of the last sentence. Prior to printing each line, we must therefore test to see if the first character of that line is a space. If it is, it is skipped and the line retested for another leading blank. When the first character is finally not a space, we retest the length of the line to be printed, since after incrementing E while skipping the leading blanks, E may have grown larger than the length of E$. This sequence starts in line 590 of TXTEDIT2.

More Sophistication

Though not demonstrated in TXTEDIT2, there are other text editing techniques you might like to try. The right margin may be justified by determining the length of a line as it will be finally printed, subtracting that from the requested line length, and thereby calculating the number of additional blanks that must be inserted in the line to make it equal the requested length. Starting at the last character and moving backwards, test for a blank and insert one of the extra blanks in that space; then on to the next blank. An intermediate string variable must be set up in which all the characters from the end to the first space encountered from the end will be renumbered from the requested line length L, on down. The extra space may be added, and then the next word (heading backwards) is added to the intermediated string variable, etc, until the required number of spaces have been added. If the line is exhausted before all the needed spaces have been added, run through the string again, adding more.

Form feeding at the end of a page to the top of the next page may be implemented by adding a counting variable to the loop that prints each line of text. When the counter reaches the requested page length (in lines), the program jumps to a subroutine which issues the number of PRINTs specified to reach the top of the next page. If the page length and page spacing are entered as variables, the page size may be varied from address labels to poster size sheets.

A line oriented text editor allowing modification of the text after input could be implemented by displaying several lines at a time, each with a number. Then, by asking the user if there are any changes to be made to any of the lines, and requesting the particular line number, the program may redefine the string variable containing that line to contain a newly entered line. A little cleverness with the use of the INP(expr) instruction might allow the user to space over the unchanged portions of the line, and change only the part typed over.

A Note About TXTEDIT2

In North Star BASIC, the PRINT, INPUT, LIST, and LINE instructions allow an optional specification of the input/output (IO) device to be used with the instruction. By using PRINT#1, the serial IO port is selected. By writing a program with a variable in place of the device select number, it may be user selected to run on any of the available devices. This was done in TXTEDIT2 and may be changed to the usual PRINT and INPUT instructions for use with other BASICs.

Conclusions

While TXTEDIT2 cannot be merely appended to your BASIC programs, the techniques discussed in this article and demonstrated in TXTEDIT2 will enable you to select the text editing functions you need and synthesize them into an efficient part of your own programs. Any suggestions you may have regarding this material or other text editing functions will be welcomed.■

Ease Into 16-Bit Computing

Part 2: Examining a Small Multi-User System

Steve Ciarcia
POB 582
Glastonbury CT 06033

In computer club meetings, in software-development groups, and among hardware designers, the terms multiprogramming, multiprocessing, and multitasking are often heard. Now that we have a few years of experience in microprocessing, the prefix *multi* has become prevalent. I define multi as an indication of the ability of a system to seemingly process more than one function at a time.

Multiprogramming, as I refer to it, is a form of program execution that allows more than one user to access the resources of a computer system at (apparently) the same time. Rather than denoting the execution of multiple programs simultaneously, which requires the use of more than one processor, multiprogramming implies a division of a single processor's time and resources. A computer executes commands faster than any single human user can enter data or instructions. A user in such a situation may never realize that there are other users connected to the same computer.

Because the input and output are being performed by the operator at human speed (which is extremely slow relative to the speed of the microprocessor), most of the processor's time in a single-user system is spent waiting for the operator to enter information, or for an output device to display the information being sent by the processor. The ratio of time the computer spends in useful activity to time the computer spends waiting is very small. Multiprogramming takes advantage of this relatively large amount of wait time by using it to execute a request from one of the other concurrent users. Of course, as the number of users on the system increases, the operator response time

Surprisingly little hardware is required to support a multi-user system running Tiny BASIC.

(ie: the amount of time it takes for the computer to respond to a specific request from an operator) will become longer and longer until it reaches some unacceptable limit. In order to maximize the number of users that may use the system concurrently with acceptable response time, the operating system may be tailored to a particular type of application.

Your first question may be, "How much hardware is required to support a multi-user system running a high-level language such as BASIC?" The answer: surprisingly little. Because of the 16-bit processing features of the Intel 8088, which I outlined last month, a multi-user operating system can be provided with a computer consisting of as few as five integrated circuits.

It is beyond the scope of this article to discuss and list the entire assembly code of the Tiny BASIC system written for the 8088. The assembly listing of the 2 K-byte interpreter is thirty-one pages long.

Readers who are interested in using the 8088 for a similar application are advised to contact the manufacturer directly. Intel is publishing an application note describing a small (seven integrated circuits) multi-user Tiny BASIC system that uses the 8088. There was discussion at the time of this writing (January 1980) that a printed-circuit board of the expanded circuit would be available for sale as well.

For this information contact:

Tom Cantrell
Marketing Communications
Intel Corporation
3065 Bowers Ave
Santa Clara CA 95051

Minimum System Hardware

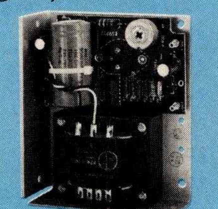
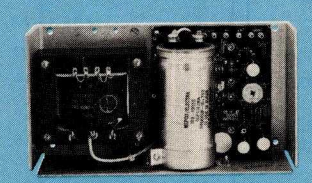
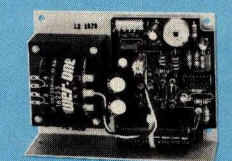
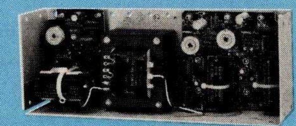
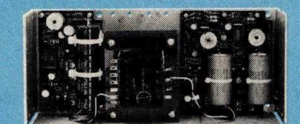
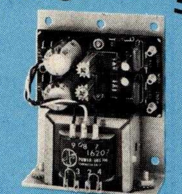
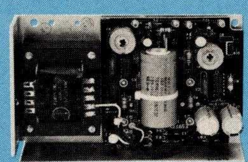
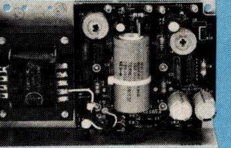
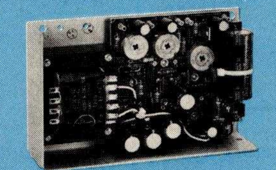
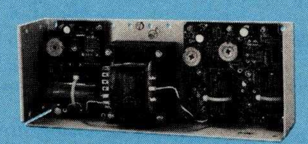
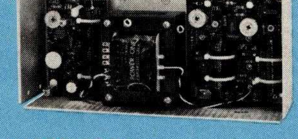
The five integrated circuits required to build a workable system include the 8088 microprocessor; the 8284 clock generator; the 8155 memory, input/output (I/O), and timer device; and the 8185 erasable programmable read-only memory

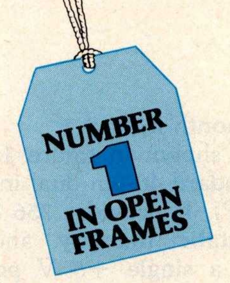
POWER-ONE D.C. POWER SUPPLIES

Now available for small systems applications

Power-One, the leader in quality open-frame power supplies, now offers a complete line of single, dual, and triple output models for small computer systems. Also available are special purpose models for Floppy Disk and Microcomputer applications.

Below are just a few popular examples of the over 90 "off the shelf" models now available from stock.

SINGLE OUTPUT & LOGIC POWER SUPPLIES • 56 "off the shelf" models • 2V to 250V, 0.1A to 40A • ±.05% regulation • 115/230 VAC input	**5V @ 3A, w/OVP**  HB5-3/OVP $24.95 single qty.	**5V @ 12A, w/OVP**  HD5-12/OVP $79.95 single qty.	**5V @ 40A, w/OVP** **NEW** SK5-40/OVP Switching Model $250.00 single qty.
FLOPPY-DISK SERIES • 8 "off the shelf" models • Powers most popular drives • Single/dual drive applications • 2-year warranty	**5V @ 0.7A, w/OVP** **12V @ 1.1A/1.7A PK** **NEW**  CP340 For one 5.25" Media Drive $44.95 single qty.	**5V @ 1A, w/OVP** **−5V @ 0.5A, w/OVP** **24V @ 1.5A/1.7A PK**  CP205 For one 8.0" Media Drive $69.95 single qty.	**5V @ 2.5A, w/OVP** **−5V @ 0.5A, w/OVP** **24V @ 3A/3.4A PK**  CP206 For two 8.0" Media Drives $91.95 single qty.
DUAL OUTPUT MODELS • 15 "off the shelf" models • ±5V to ±24V, 0.25A to 6A • I.C. regulated • Full rated to +50°C	**12V/15V @ 0.25A** **NEW**  HAD12-.25/HAD15-.25 $32.95 single qty.	**5V @ 2A, w/OVP** **9−15V @ 0.5A**  HAA512 $44.95 single qty.	**±12V @ 1.7A or** **±15V @ 1.5A**  HBB15-1.5 $49.95 single qty.
TRIPLE OUTPUT MODELS • 10 "off the shelf" models • 5V plus ± 9V to ± 15V outputs • Models from 16W to 150W • Industry standard size	**5V @ 2A, w/OVP** **± 9V to ± 15V @ 0.4A**  HTAA-16W $49.95 single qty.	**5V @ 3A, w/OVP** **± 12V @ 1A or** **± 15V @ 0.8A**  HBAA-40W $69.95 single qty.	**5V @ 6A, w/OVP** **± 12V @ 1.7A or** **± 15V @ 1.5A**  HCBB-75W $91.95 single qty.



NEW 79' CATALOG!

Get Your FREE Copy Now!

Phone us direct or circle the reader service number below.

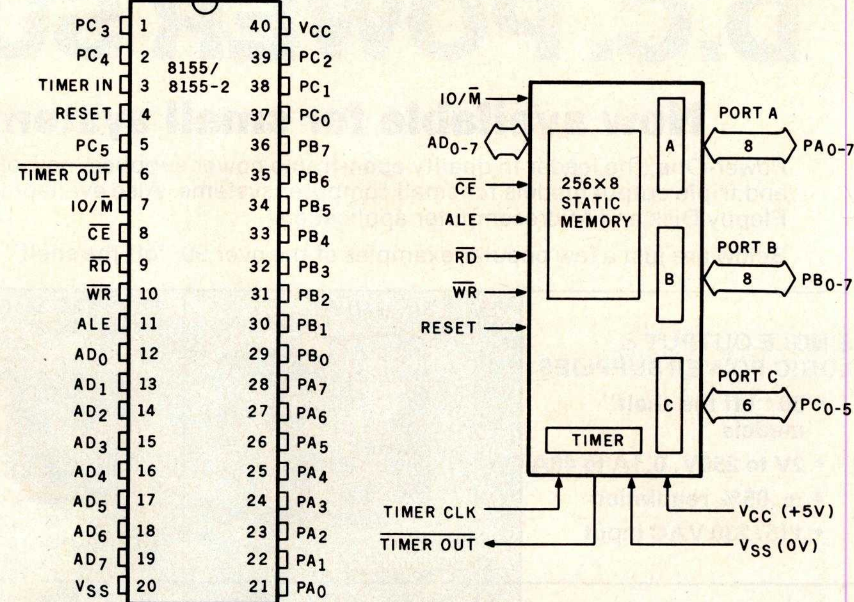





Power One Drive • Camarillo, CA 93010 • (805) 484-2806 • TWX 910-336-1297

Circle 52 on inquiry card.

Circle 17 on inquiry card.



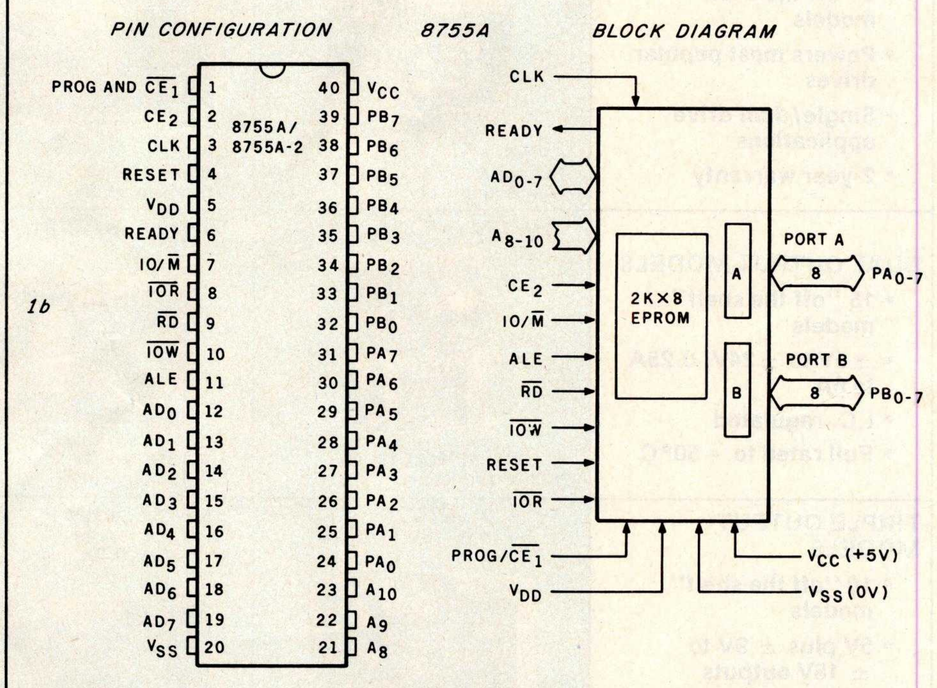


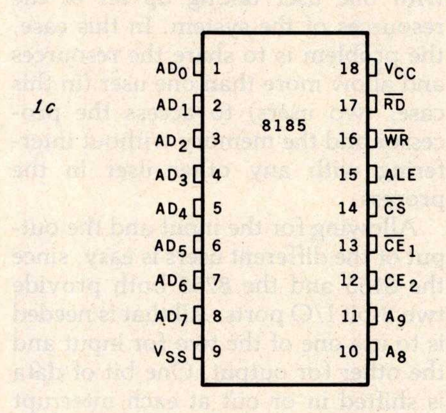
Figure 1: *Integrated circuits that perform support functions for the 8088 in the minimum-configuration system discussed in this article.*
(1a) The 8155 static memory, I/O, and timer device.
(1b) The 8755A EPROM and I/O device.
(1c) The 8185 1 K-byte static memory part.
(1d) The 8284 clock generator/driver device.

(EPROM) and I/O device, all from Intel Corporation.

The 8088, residing in a 40-pin package, executes the complete 16-bit instruction set of the 8086 microprocessor, while communicating over an 8-bit data bus. The 8088 was discussed last month in Part 1.

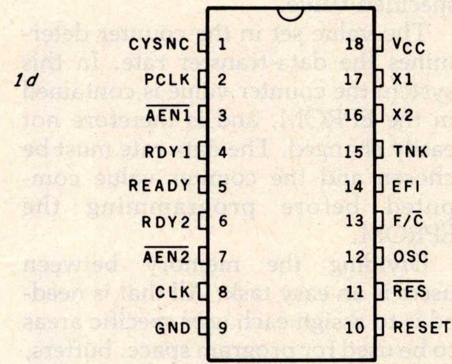
The 8155, shown in figure 1a, is also in a standard 40-pin dual in-line package (DIP). It provides 256 8-bit words of static memory and is powered by a single +5 V power supply. Since it is static memory, no

PIN CONFIGURATION 8185 BLOCK DIAGRAM



CS
CE1
CE2
RD
WR
ALE
READ/WRITE LOGIC
AD0-AD7
DATA BUS BUFFER
1K×8 PROGRAMMABLE MEMORY ARRAY
X-Y DECODE
A8,A9
ALE
ADDRESS LATCH

PIN CONFIGURATION 8284 BLOCK DIAGRAM



RES
D Q
RESET
X1
X2
TANK
CRYSTAL OSCILLATOR
CK
OSC
CLK
F/C
EFI
÷3 SYNC
÷2 SYNC
PCLK
CSYNC
RDY1
AEN1
AEN2
RDY2
CK
D Q
READY

refresh circuitry is required.

In addition to the memory and a programmable timer, the 8155 also provides two programmable 8-bit I/O ports and one 6-bit programmable I/O port. The high-order bit of port B is chosen as the serial input line for one of the two user terminals, and the low-order bit of port A is used as the serial output line for the same terminal.

Figure 1b presents the internal block diagram of the 8755A. The 8755A combines EPROM and I/O functions. The EPROM contains the system software; the I/O ports serve the second user's terminal.

The last major part in the system is the 8185, which contains 1 K bytes of static memory. (See figure 1c.) It is used by the system as the major block of memory allocated for program storage.

All of these integrated circuits are specifically designed to work with the multiplexed address and data buses. Hence, there is no need to have any outside latches to provide address signals for their operation. Address latching for each device is provided internally.

All of the integrated circuits used in this design are directly compatible with the 5 MHz signal which is generated by the 8284 clock generator (figure 1d); however, the 8155 timer/counter appears to work better if driven by the 2.5 MHz signal that is output on the PCLK line of the 8284.

Figure 2 is a diagram that demonstrates the flow of data in the 5-chip system, as well as the addresses of the memory and the I/O ports. To allow for service to multiple simultaneous users, the *timer-in* line in the 8155 is wired to the PCLK line in the 8284. Also, the *timer-out* line is tied to the nonmaskable interrupt (NMI) line of the 8088 microprocessor.

Developing the Operating System

There are many problems associated with writing a BASIC interpreter for such a limited system. Approaches taken on large computers are not necessarily applicable. Tiny BASIC is usually written to work with one user taking up all of the resources of the system. In this case, the problem is to share the resources and allow more than one user (in this case, two users) to access the processor and the memory without interfering with any other user in the process.

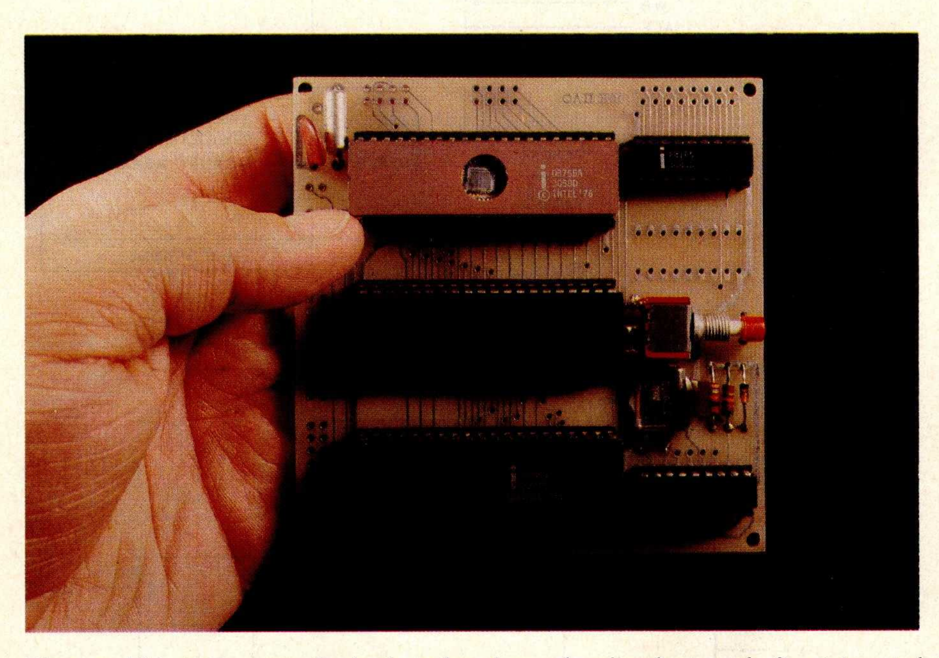


Photo 1: *This 8088 system fits in the palm of your hand and uses only five integrated circuits. It contains enough read-only and programmable memory, and sufficient peripheral interfaces, to support two 300 bps terminals, running a Tiny BASIC interpreter on each.*

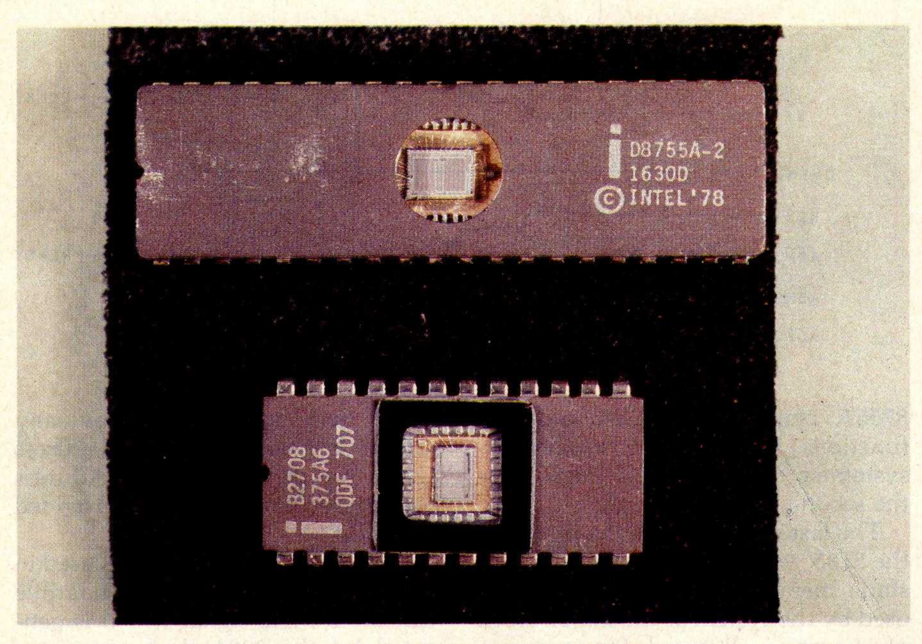


Photo 2: *Side-by-side comparison of the 8755 EPROM, top, and the older 2708 EPROM. The difference in package size is due to the presence of I/O ports on the 8755. The 8755 requires a single 5-V power supply and contains 2 K bytes of memory; the 2708 requires three different power supply voltages (+5 V, +12 V, and −12 V) and contains 1 K bytes of EPROM.*

Allowing for the input and the output of the different users is easy, since the 8155 and the 8755 both provide two 8-bit I/O ports. All that is needed is to use one of the two for input and the other for output. One bit of data is shifted in or out at each interrupt from the timer.

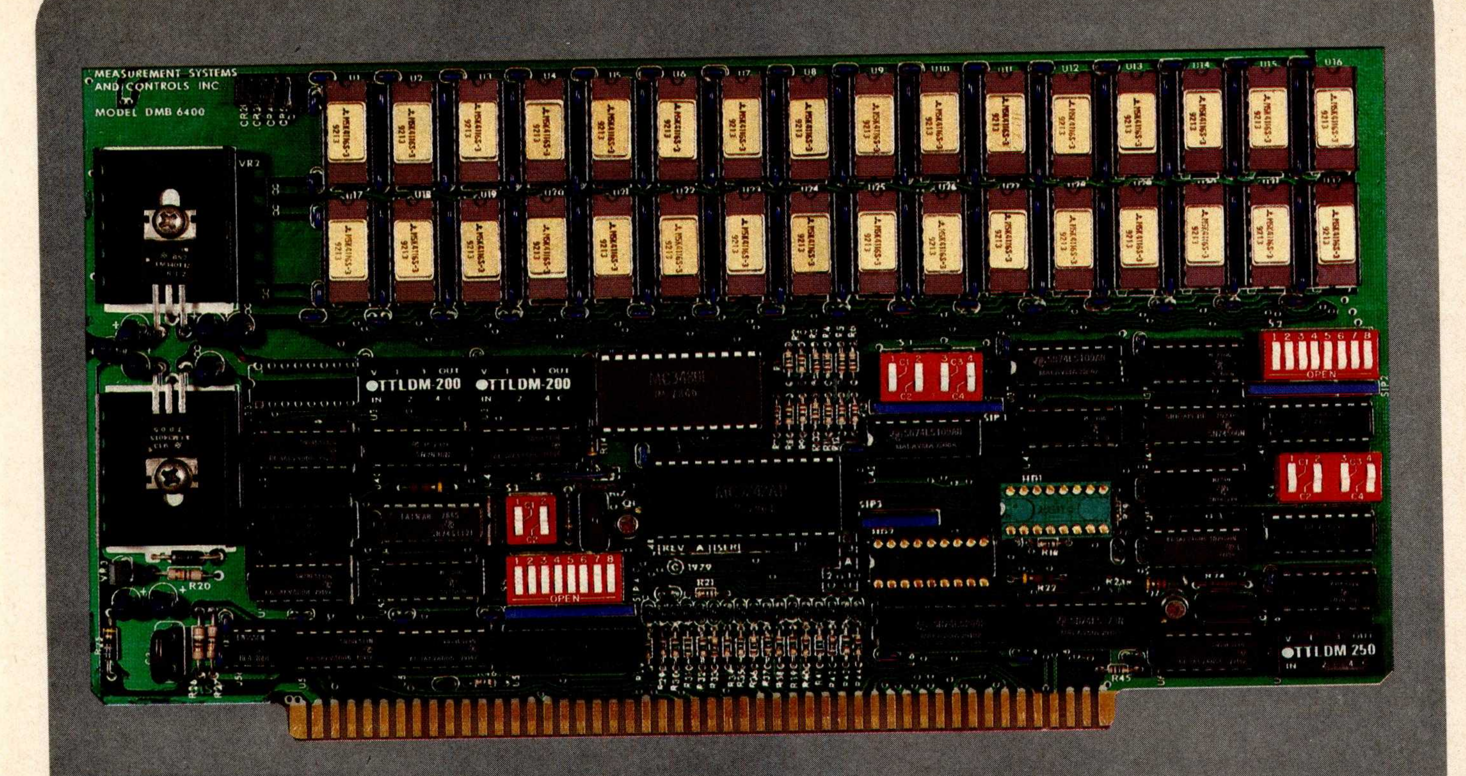
The data rate for communication with the user terminals is obtained by using the programmable timer in the 8155 as a data-rate generator. The 14-bit binary counter is preset during the initialization routine of the system. Once set, the counter continuously counts up and generates an interrupt signal when it reaches the specified value.

The value set in the counter determines the data-transfer rate. In this system the counter value is contained in the EPROM, and is therefore not easily changed. The data rate must be chosen and the counter value computed before programming the EPROM.

Dividing the memory between users is an easy task. All that is needed is to assign each user specific areas to be used for program space, buffers, and stacks. This does limit the size of the programs that may be entered by each user, but from an operating-system viewpoint, the assignment of space is an easy task. A memory map is outlined in figure 3.

The problem of memory allocation in this situation is getting the processor to differentiate between users, buffers, and programs. Since there are 2 K bytes of EPROM to contain all of the system programs, it would be easy for the operating system to use all of the memory space in just initializing the two user terminals. An easy, efficient method of differentiating the two users is required.

Another consideration in the interest of total system efficiency is the allocation of more execution time to one of the users if the other user has his job executing some kind of I/O



BANK SELECT — 64K BYTE EXPANDABLE MEMORY BOARD

MODEL DMB6400 SERIES

FULLY COMPATIBLE WITH:

ALPHA MICRO

CROMEMCO

NORTH STAR

MP/M

and most other S-100 systems

- Four independent, 16K software selectable banks.
- Switch selectable bank sizes — from 16K to 64K in 16K increments.
- Eight banks (512K) per I/O port for each of the 256 ports.
- Z-80 4MHz operation with no wait states.
- Low power — 8 watts maximum.
- Reliable, tested and burned-in memory.
- **ONE YEAR GUARANTEE**
- IEEE S-100 compatible timing.
- Attractive Dealer & OEM Prices

MEASUREMENT systems & controls incorporated

867 North Main Street • Orange, CA 92668
Telephone: 714/633-4460

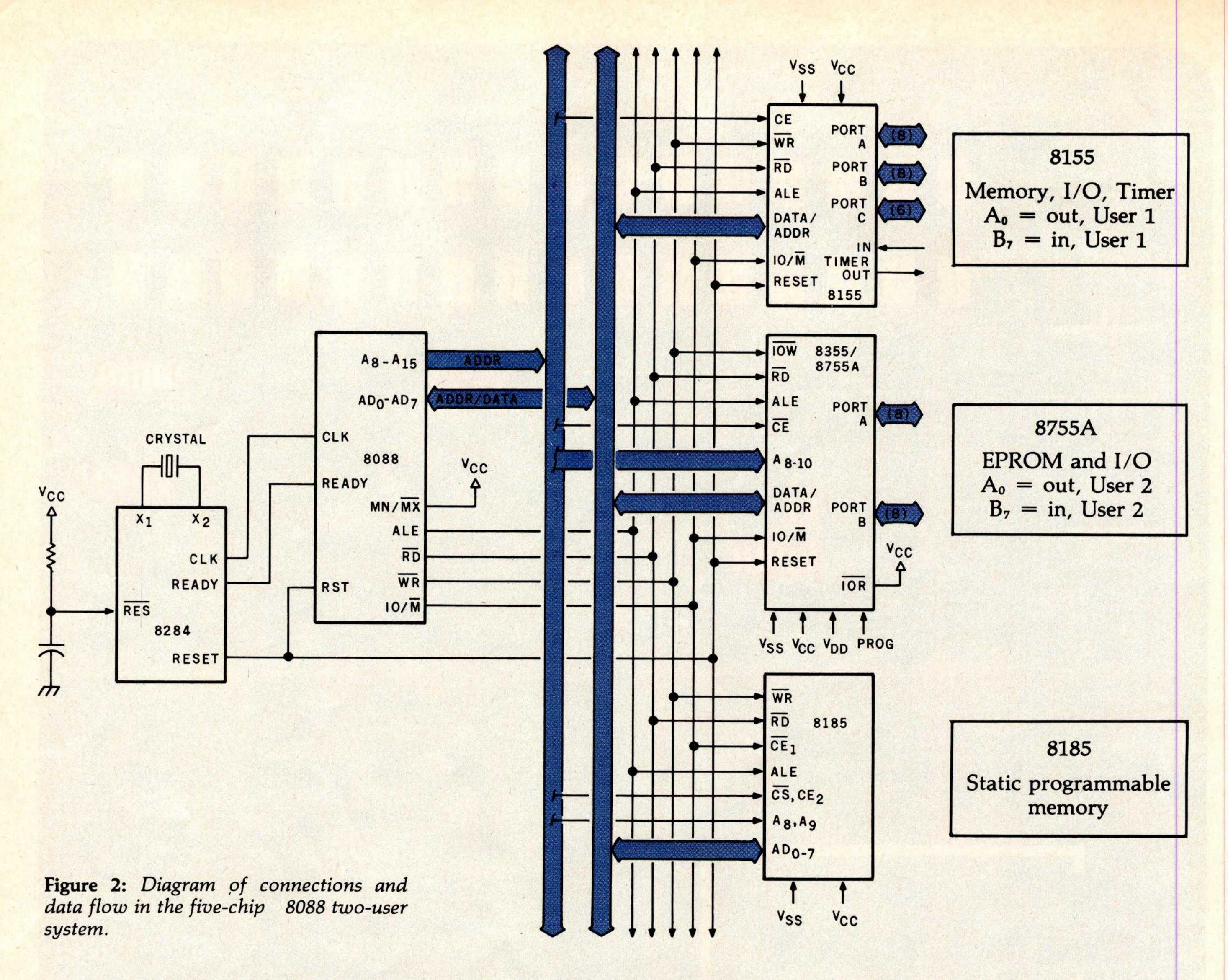


Figure 2: *Diagram of connections and data flow in the five-chip 8088 two-user system.*

Device	Type	Hexadecimal Address
8155	programmable	00 thru FF
8185	programmable	1000 thru 13FF
8755A	EPROM	0F800 thru 0FFFF

Table 1: *Memory addressing in the 8088 system.*

Device	Function	Hexadecimal Address
8155	Command-Status Register	00
	Port A	01
	Port B	02
	Port C	03
	Timer (low)	04
	Timer (high)	05
8755A	Port A	F000
	Port B	F001
	Data-Direction Register A	F002
	Data-Direction Register B	F003

Table 2: *I/O addressing in the 8088 system.*

wait loop. Normally, the processor will switch the current user-task being executed each time it receives an interrupt from the timer. This way, each user-task will receive an equal amount of execution time on the system.

However, while the system is waiting for a user to enter commands or while it is sending information to the terminal, it has no productive task to perform for that user. If both users are in an I/O mode, as at system-startup time, then the processor enters a wait loop, waiting for the interrupts from the timer. This way, as much as possible, the processor will split time with both users effectively.

Solving the Problems

The biggest concern, differentiation between the two users and their respective buffers and programs, was the easiest to solve with the 8088 microprocessor. This processor, like

CP/M* VERSION 2 FOR TRS-80* MODEL II NOW AVAILABLE

Prices reflect distribution on 8" single density diskettes. If a format is requested which requires additional diskettes, a surcharge of $8. per additional diskette will be added.

All Lifeboat programs require CP/M, unless otherwise stated.

Software with Manual / Manual Alone

☐ **CP/M FLOPPY DISKETTE OPERATING SYSTEM** — Packages supplied on diskette complete with 8080 assembler, text editor, 8080 debugger and various utilities plus full documentation. CP/M available configured for most popular computer/disk systems including: North Star Single, Double or Quad density, Altair 8" disks, Helios II, Exidy Sorcerer, Vector MZ, Heath H17† or H89†, TRS-80†, iCOM 3712 and iCOM Micro Disk plus many other configurations available off the shelf .... **$145/$25**

☐ **CP/M** version 2 (not all formats available immediately) .... **$170/$25**

☐ **MP/M*** .... **$300/$50**

all Microsoft prices are discounted!

MICROSOFT

☐ **BASIC-80** — Disk Extended BASIC, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records .... **$300/$25**

☐ **BASIC COMPILER** — Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes MACRO-80 Also linkable to FORTRAN-80 or COBOL-80 code modules .... **$350/$25**

☐ **FORTRAN-80** — ANSI 66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) .... **$400/$25**

☐ **COBOL-80** — Level 1 ANSI '74 standard COBOL plus most of Level 2. Full sequential, relative, and indexed file support with variable file names. STRING, UNSTRING, COMPUTE, VARYING/UNTIL, EXTEND, CALL, COPY, SEARCH, 3-dimensional arrays, compound and abbreviated conditions, nested IF. Powerful interactive screen-handling extensions. Includes compatible assembler, linking loader, and relocatable library manager as described under MACRO-80 .... **$625/$25**

☐ **MACRO-80** — 8080/Z80* Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included .... **$149/$15**

☐ **XMACRO-86** — 8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available .... **$275/$25**

☐ **EDIT-80** — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included. .... **$89/$15**

DIGITAL RESEARCH

☐ **MAC** — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) .... **$120/$15**

☐ **SID** — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values .... **$105/$15**

☐ **ZSID** — As above for Z80. Requires Z80 CPU **$130/$25**

☐ **TEX** — Text formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer .... **$105/$15**

☐ **DESPOOL** — Program to permit simultaneous printing of data from disk while user executes another program from the console .... **$80/$5**

MICRO FOCUS

☐ **STANDARD CIS COBOL** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... **$850/$50**

☐ **FORMS 2** — CRT screen editor. Output is COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by CIS COBOL (standard) .... **$200/$20**

☐ **HDBS** — Hierarchical Data Base System. CODASYL oriented with FILEs, SETs, RECORDs and ITEMs which are all user defined. ADD, DELETE, UPDATE, SEARCH, and TRAVERSE commands supported. SET ordering is sorted, FIFO, LIFO, next or prior. One to many set relationship supported. Read/Write protection at the FILE level. Supports FILEs which extend over multiple floppy or hard disk devices.

☐ **MDBS** — Micro Data Base System. Full network data base with all features of HDBS plus multi-level Read/Write protection for FILE, SET, RECORD and ITEM. Explicit representation of one to one, one to many, many to many, and many to one SET relationships. Supports multiple owner and multiple record types within SETs. HDBS files are fully compatible.

☐ **MDBS-DRS** — MDBS with Dynamic Restructuring System option which allows altering MDBS data bases when new ITEMs, RECORDs, or SETs are needed without changing existing data.

HDBS-Z80 version .... **$250/$35**
MDBS-Z80 version .... **$750/$35**
MDBS-DRS-Z80 version .... **$850/$40**
8080 Version available at $75. extra.

NOTE → Z80 version requires 20K RAM. 8080 version requires 24K RAM. (Memory requirements are additional to CP/M and application program.)

When ordering HDBS or MDBS please specify if the version required is for 1) Microsoft L80 i.e. FORTRAN-80, COBOL-80, BASIC COMPILER, 2) MBASIC 4. XX, or 3) BASIC-80 5.0.

Prices and specifications subject to change without notice.

Lower prices!

EIDOS SYSTEMS

☐ **KISS** — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80, etc. .... **$335/$23**

☐ **KBASIC** — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS. REL as described above, and a sample mail list program .... **$585/$45**
To licensed users of Microsoft BASIC-80 (MBASIC) .... **$435/$45**

all Micropro prices are discounted!

MICROPRO

☐ **SUPER-SORT I** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. Even variable number of fields per record! **$225/$25**

☐ **SUPER-SORT II** — Above available as absolute program only .... **$175/$25**

☐ **SUPER-SORT III** — As II without SELECT/EXCLUDE .... **$125/$25**

☐ **WORD-STAR** — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace, Read/Write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning .... **$445/$40**

☐ **WORD-STAR/MAIL-MERGE** — As above with option for production mailing of personalized documents with mail list from Datastar or NAD .... **$575/$25**

☐ **WORD-STAR Customization Notes** — For sophisticated users who do not have one of the many standard terminal or printer configurations in the distribution version of WORD-STAR .... **NA/$95**

☐ **WORD-MASTER** Text Editor — In one mode has superset of CP/M's ED commands including global searching and replacing, forwards and backwards in file in video mode, provides full screen editor for users with serial addressable-cursor terminal .... **$125/$25**

☐ **DATASTAR** — Professional forms control entry and display system for key-to-disk data capture. Menu driven with built-in learning aids. Input field verification by length, mask, attribute (i.e. uppercase, lowercase, numeric, auto dup., etc.). Built-in arithmetic capabilities using keyed data, constants and derived values. Visual feedback for ease of forms design. Files compatible with all CP/M-MP/M supported languages. Requires 32K CP/M .... **$350/$35**

☐ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables, etc. .... **$109/$15**

☐ **PASCAL/M*** — Compiler generates P code from extended language, implementation of standard PASCAL. Supports overlay structure through additional procedure calls and the SEGMENT procedure type. Provides convenient string handling capability with the added variable type STRING. Untyped files allow memory image I/O. Requires 56K CP/M .... **$350/$30**

☐ **PASCAL/Z** — Z80 native code PASCAL compiler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, companion macro-assembler and source for the library. Requires 56K and Z80 CPU.
Version 2 includes all of Jensen/Wirth except variant records .... **$275/$25**
Version 3 with variant records and strings expected 3/80 .... **$395/$25**

New Version New Features → ☐ **PASCAL/MT** — Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Version 3 includes Sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion. Source for the run time package requires MAC (See under Digital Research). Requires 32K .... **$250/$30**

STRUCTURED SYSTEMS GROUP

☐ **GENERAL LEDGER** — Interactive and flexible system providing proof and report outputs. Customization of COA created interactively. Multiple branch accounting centers. Extensive checking performed at data entry for proof, COA correctness, etc. Journal entries may be batched prior to posting. Closing procedure automatically backs up input files. Now includes Statement of Changes in Financial Position. Requires CBASIC-2 .... **$1250/$25**

☐ **ACCOUNTS RECEIVABLE** — Open item system with output for internal aged reports and customer-oriented statement and billing purposes. On-Line Enquiry permits information for Customer Service and Credit departments. Interface to General Ledger provided if both systems used. Requires CBASIC-2. .... **$1250/$25**

☐ **ACCOUNTS PAYABLE** — Provides aged statements of accounts by vendor with check writing for selected invoices. Can be used alone or with General Ledger and/or with NAD. Requires CBASIC-2 .... **$1250/$25**

☐ **PAYROLL** — Flexible payroll system handles weekly, bi-weekly, semi-monthly and monthly payroll periods. Tips, bonuses, re-imbursements, advances, sick pay, vacation pay, and compensation time are all part of the payroll records. Prints government required periodic reports and will post to multiple SSG General Ledger accounts. Requires CBASIC-2 and 54K of memory .... **$1250/$25**

☐ **INVENTORY CONTROL SYSTEM** — Performs control functions of adding and depleting stock items, adding new items and deleting old items. Tracks quantity of items on hand, on order and back-ordered. Optional hard copy audit trail is available. Reports include Master Item List, Stock Activity, Stock Valuation and Re-order List. Requires CBASIC-2 **$1250/$25**

☐ **ANALYST** — Customized data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval, and update facility makes information management easy. Sophisticated report generator provides customized reports using selected records with multiple level break-points for summarization. Requires CBASIC-2 .... **$250/$15**

☐ **LETTERIGHT** — Program to create, edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 .. **$200/$25**

☐ **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 .... **$100/$20**

☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created .... **$100/$20**

Now-applications software for Microsoft's BASIC interpreter!

PEACHTREE SOFTWARE

New Features → ☐ **GENERAL LEDGER** — Records details of all financial transactions. Generates a balance sheet and an income statement. Flexible and adaptable design for both small businesses and firms performing client writeup services. Produces reports as follows: Trial Balance, Transaction Registers, Balance Sheet, Prior Year Comparative Balance Sheet, Income Statement, Prior Year Comparative Income Statement and Department Income Statements. Interactive with other PEACHTREE accounting packages. Supplied in source code for Microsoft BASIC .... **$990/$30**

☐ **ACCOUNTS PAYABLE** — Tracks current and aged payables and incorporates a check writing feature. Maintains a complete vendor file with information on purchase orders and discount terms as well as active account status. Produces reports as follows: Open Voucher Report, Accounts Payable Ageing Report and Cash Requirements. Provides input to PEACHTREE General Ledger. Supplied in source code for Microsoft BASIC .... **$990/$30**

☐ **ACCOUNTS RECEIVABLE** — Generates invoice register and complete monthly statements. Tracks current and aged receivables. Maintains customer file including credit information and account status. The current status of any customer account is instantly available. Produces reports as follows: Aged Accounts Receivable, Invoice Register, Payment and Adjustment Register and Customer Account Status Report. Provides input to PEACHTREE General Ledger. Supplied in source code for Microsoft BASIC .. **$990/$30**

☐ **PAYROLL** — Prepares payroll for hourly, salaried and commissioned employees. Generates monthly, quarterly and annual returns. Prepares employee W-2's. Includes tables for federal withholding and FICA as well as withholding for all 50 states plus up to 20 cities from pre-computed or user generated tables. Will print checks, Payroll Register, Monthly Summary and Unemployment Tax Report. Provides input to PEACHTREE General Ledger. Supplied in source code for Microsoft BASIC .... **$990/$30**

☐ **INVENTORY** — Maintains detailed information on each inventory item including part number, description, unit of measure, vendor and reorder data, item activity and complete information on current item costs, pricing and sales. Produces reports as follows: Physical Inventory Worksheet, Inventory Price List, Departmental Summary Report, Inventory Status Report, The Reorder Report and the Period-to-Date and Year-to-Date reports. Supplied in source code for Microsoft BASIC .... **$1,190/$30**

☐ **MAILING ADDRESS** — Keeps track of name and address information and allows the selective printing of this information in the form of mailing lists or address labels. Allows the user to tailor the system to his own particular requirements. User-defined format and print-out system uses a special format file which tells programs how to print the mailing list or address labels. Standard format files are included with system. Automatic sorting of data uses indexed file management routines which allow the name and address information to be sequentially retrieved and printed without file sorting. Supplied in source code for Microsoft BASIC .... **$790/$30**

GRAHAM-DORIAN SOFTWARE SYSTEMS

☐ **GENERAL LEDGER** — An on-line system; no batching is required. Entries to other GRAHAM-DORIAN accounting packages are automatically posted. User establishes customized C.O.A. Provides transaction register, record of journal entries, trial balances and monthly closings. Keeps 14 month history and provides comparison of current year with previous year. Requires CBASIC-2. Supplied in source ... **$995/$35**

☐ **ACCOUNTS PAYABLE** — Maintains vendor list and check register. Performs cash flow analysis. Flexible — writes checks to specific vendor for certain invoices or can make partial payments. Automatically posts to GRAHAM-DORIAN General Ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source .... **$995/$35**

☐ **ACCOUNTS RECEIVABLE** — Creates trial balance reports, prepares statements, ages accounts and records invoices. Provides complete information describing customer payment activity. Receipts can be posted to different ledger accounts. Entries automatically update GRAHAM-DORIAN General Ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source .... **$995/$35**

☐ **PAYROLL SYSTEM** — Maintains employee master file. Computes payroll withholding for FICA, Federal and State taxes. Prints payroll register, checks, quarterly reports and W-2 forms. Can generate ad hoc reports and employee form letters with mail labels. Requires CBASIC-2. Supplied in source .... **$590/$35**

☐ **INVENTORY SYSTEM** — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC-2. Supplied in source ... **$590/$35**

☐ **JOB COSTING** — Designed for general contractors. To be used interactively with other GRAHAM-DORIAN accounting packages for tracking and analysing expenses. User establishes customized cost categories and job phases. Permits comparison of actual versus estimated costs. Automatically updates GRAHAM-DORIAN General Ledger or runs as stand alone system. Requires CBASIC-2. Supplied in source **$995/$35**

☐ **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC-2. Supplied in source .... **$590/$35**

☐ **CASH REGISTER** — Maintains files on daily sales. Files data by sales person and item. Tracks sales, over-rings, refunds, payouts and total net deposits. Requires CBASIC-2. Supplied in source ... **$590/$35**

☐ **tiny C** — Interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... **$105/$40**

New Features → ☐ **BDS C COMPILER** — Supports most major features of language including Structures, Arrays, Pointers, recursive function evaluation, linking loader and library. Floating point function library included. Lacks data initialization and static and register class specifiers. Documentation includes "THE C PROGRAMMING LANGUAGE" by Kernighan and Ritchie. .... **$125/$15**

☐ **WHITESMITHS C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX* Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M .... **$630/$30**

☐ **POLYVUE/80** — Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual .... **$135/$15**

☐ **POLYTEXT/80** — Text formatter for word processing applications. Justifies and paginates source text files. Will generate form letters with custom fields and conditional processing. Support for Daisy Wheel printers includes variable pitch justification and motion optimization .... **$85/$15**

☐ **ALGOL-60** — Powerful block-structured language compiler featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. Requires Z80 CPU .... **$199/$20**

☐ **Z80 DEVELOPMENT PACKAGE** — Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file .... **$95/$20**

☐ **ZDT** — Z80 Monitor Debugger to break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. $35 when ordered with Z80 Development Package .... **$50/$10**

☐ **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080 .... **$65/$10**

☐ **DISILOG** — As DISTEL to Zilog/Mostek mnemonic files. Runs on Z80 only .... **$65/$10**

☐ **XASM-68** — Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to Intel hex .... **$200/$25**

☐ **XASM-65** — As XASM-68 for MOS Technology MCS-6500 series mnemonics .... **$200/$25**

☐ **TEXTWRITER III** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertions. Ideal for contracts, manuals, etc. Now compatible with Electric Pencil* prepared files. .... **$125/$20**

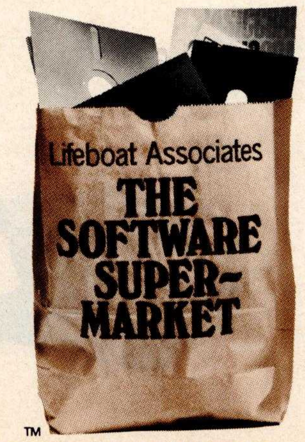
New Features → ☐ **POSTMASTER** — A comprehensive package for mail list maintenance that is completely menu driven. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Compatible with NAD files. Requires CBASIC-2 .... **$150/$15**

☐ **WHATSIT?*** Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC-2 .... **$125/$25**

Shopping List No.11

Software for most popular 8080/Z80 computer disk systems including ***NORTH STAR, iCOM, MICROPOLIS, DYNABYTE DB8/2 & DB8/4, EXIDY SORCERER, SD SYSTEMS, ALTAIR, VECTOR MZ, MECA, 8" IBM, HEATH H17 & H89, HELIOS, IMSAI VDP42 & 44, REX, NYLAC, INTERTEC, VISTA V80 and V200, TRS-80 MODEL I and MODEL II, ALTOS, OHIO SCIENTIFIC DIGI-LOG, KONTRON PSI80*** *and* ***IMS 5000*** *formats.*

Everything on Shopping List #11 runs on 64K TRS-80 Model II



Lifeboat Associates, 2248 Broadway, N.Y., N.Y. 10024 **(212) 580-0082** Telex: 220501

```
620 REM          ***   INSTRUCTION IN I CHINGING
630 CLS
640 PRINT"THE I CHING IS ONE OF THE OLDEST BOOKS OF CHINESE PHILOSOPHY.
650 PRINT"ALTHOUGH ITS AUTHORSHIP IS UNCERTAIN, IT IS CONFUCIAN IN MOOD.
660 PRINT"TO CONSULT THE I CHING ONE MUST FIRST CONSTRUCT A HEXAGRAM,
670 PRINT"CONSISTING OF SIX LINES, EACH LINE OF EITHER OF TWO POSSIBLE
680 PRINT"TYPES, BROKEN OR CONTINUOUS, ARRANGED ONE ABOVE THE OTHER TO
690 PRINT"FORM AN OPEN-SIDED RECTANGLE.
700 PRINT"A LINE MAY LOOK LIKE THIS:
710 FORI=6TO56:SET(I,23):NEXTI:FORJ=66TO115:SET(J,23):NEXT
720 PRINT@576,"OR IT MAY LOOK LIKE THIS:
730 FORI=6TO115:SET(I,33):NEXT
740 PRINT@768,"AND THE POSITION OF THE LINE IN THE HEXAGRAM, AS WELL AS THE
750 PRINT"TYPE OF LINE, IS IMPORTANT IN ITS INTERPRETATION.
760 PRINT:INPUT"PRESS <ENTER> TO CONTINUE";EN
770 CLS:PRINT"THE HEXAGRAM IS COMPOSED OF TWO TRIGRAMS, AN UPPER AND A LOWER.
780 PRINT"EACH TRIGRAM, AS WELL AS EACH LINE IN IT, HAS INTERPRETIVE
790 PRINT"POSSIBILITIES.
800 PRINT"SO YOUR CHANCES OF WORKING OUT SOLUTIONS TO THE PROBLEMS ON
810 PRINT"WHICH YOU CONSULT THE I CHING DEPEND UPON:
820 PRINT:PRINT"     A. THE HEXAGRAM YOU CAST, WHICH CAN BE ANY OF
830 PRINT"     64 POSSIBLE FORMS, AND ITS UNIQUE DESCRIPTION;
840 PRINT:PRINT"     B. THE TYPES AND POSITIONS OF THE TWO TRIGRAMS
850 PRINT"     WHICH COMPOSE IT (8 POSSIBLE TYPES); AND THE
860 PRINT:PRINT"     C. TYPES AND POSITIONS OF EACH OF THE SIX LINES,
865 PRINT"     READING FROM THE BOTTOM LINE UPWARDS.
870 PRINT:PRINT:INPUT "PRESS <ENTER> TO CONTINUE";
880 CLS:PRINT:PRINT"IT IS EASY TO SEE THAT A LOT OF INFORMATION CAN BE DERIVED
890 PRINT"FROM A SINGLE HEXAGRAM.  IN FACT, YOUR OWN INTERPRETATION OF
900 PRINT"THE HEXAGRAM IS THE MOST IMPORTANT PART OF THE ACTION.
910 PRINT"IT IS ESSENTIAL FOR YOU TO THINK SERIOUSLY ABOUT THE TEXT THAT
920 PRINT"DESCRIBES THE LINES, TRIGRAMS AND HEXAGRAMS, TO SEE HOW ITS
930 PRINT"GENERAL MEANINGS CAN BE APPLIED TO YOUR PARTICULAR CASE."
940 PRINT"THIS PROGRAM WILL CAST A HEXAGRAM AT YOUR DISCRETION, AND IT
950 PRINT"WILL PRINT OUT THE REFERENCE CODE OF THE HEXAGRAM IN THE LOWER
960 PRINT"LEFT HAND CORNER OF THE VIDEO SCREEN.  THE FIRST DIGIT REFERS
970 PRINT"TO THE BOTTOM LINE OF THE HEXAGRAM AND THE LAST DIGIT REPRE-
980 PRINT"SENTS THE TOP LINE.  AN ODD NUMBER (9) MEANS A SOLID LINE AND
990 PRINT"AN EVEN NUMBER (6) IS A BROKEN LINE.  SEE ANY I CHING TEXT FOR
1000 PRINT"AN EXPLANATION OF ITS USE AND INTERPRETATION.":PRINT
1010 INPUT"PRESS <ENTER> TO RETURN TO THE MAIN PROGRAM";EN
1020 RETURN
```

Listing 1: *Program to cast the* I Ching, *written in BASIC for the Radio Shack TRS-80, Level II microcomputer. The PRINT@ statements cause output to appear at designated locations on the video display screen. The CLS statements cause the display screen to be cleared.*

```
10 REM  *** CASTING THE I CHING
20 REM  *** PART I OF 2 PROGRAMS FOR USING THE ANCIENT CHINESE
30 REM  *** BOOK OF WISDOM CALLED THE I CHING
40 REM  *** THIS PROGRAM PROVIDES SOME BACKGROUND INSTRUCTION
50 REM  *** ALONG WITH FACILITIES FOR CASTING THE HEXAGRAMS.
60 REM  *** PART II WILL PROVIDE INTERPRETIVE DOCUMENTATION.
70 REM  *** PROGRAMS ARE BY E. STEWART DETHLEFSEN
80 REM  *** DEPARTMENT OF ANTHROPOLOGY
90 REM  *** COLLEGE OF WILLIAM & MARY
100 REM *** WILLIAMSBURG, VA 23185  ((804)253 4369)
110 REM *** COPYRIGHT 1980, EDWIN DETHLEFSEN
120 CLS:PRINT@388,"***  THE OLD CHINESE SEER PRESENTS THE YI CHING  ***
130 FORI=1TO1500:NEXT
140 CLS:PRINT:PRINT:PRINT"THIS IS YOUR CHANCE TO GET STRAIGHT ANSWERS TO THE REALLY
150 PRINT"IMPORTANT QUESTIONS.  BEST OF ALL, YOU GET TO MAKE THOSE
160 PRINT"ANSWERS STRAIGHT YOURSELF, WHICH MAY CAUSE YOU TO RE-EXAMINE
170 PRINT"THE QUESTIONS!":PRINT
180 PRINT"IN SHORT, THE I CHING IS NOT A GAME BUT A PHILOSOPHY.
190 PRINT"A PHILOSOPHY IS A WAY OF SEEING, NOT A WAY OF 'DOING'.
200 PRINT"THE I CHING IS BASED ON THE IDEA THAT SEEING CLEARLY MUST
210 PRINT"HAPPEN BEFORE ACTION CAN BE MEANINGFUL.
220 PRINT:PRINT"FOR INSTRUCTIONS ENTER <1>; TO CAST A HEXAGRAM ENTER <2>";
230 REM *** BRIEF OR PROCEED
240 INPUTD:IFD=1GOSUB620
250 CLS:INPUT"WHEN YOU ARE READY TO CAST A HEXAGRAM PRESS ENTER:";EN
260 CLS:FORI=1TO1000:NEXT:RESTORE
270 REM ***  MIND READINESS
280 FORI=1TO1000STEP66:PRINT@I,"%%%% C O N C E N T R A T E %%%%":FORJ=1TO50:NEXT
J:NEXTI
290 PRINT@457,"C * O * N * C * E * N * T * R * A * T * E
300 Q=24:R=19
310 FORL=1TO127:SET(L,Q):NEXTL
320 FORM=127TO1STEP-1:RESET(M,Q):NEXTM
330 FORN=127TO1STEP-1:SET(N,R):NEXTN
340 FORP=1TO127:RESET(P,R):NEXTP
350 Q=Q+3:R=R-3:IFQ>44ANDR<5THEN360ELSE310
360 CLS:FORI=1TO1500:NEXTI
370 REM ***  RANDOMIZE THE HEXAGRAM AND SET LINES
380 FORK=36TO1STEP-7
390 A=RND(2)
400 IFA=1GOSUB540
410 IFA=2GOSUB580
420 GOSUB600:NEXTK
430 PRINT@832,Z(1);Z(2);Z(3);Z(4);Z(5);Z(6)
440 REM ***  TIME TO LOOK AND DECIDE
450 FORI=1TO3000:NEXTI
460 PRINT@896,"ANOTHER CAST? (YES=1/NO=2)";
470 INPUTB:IFB=2THEN520
480 REM ***  ERASE OLD HEXAGRAM
490 FORK=1TO36STEP7
500 FORI=1TO115
510 RESET(I,K):NEXTI:NEXTK:GOTO260
520 INPUT"THANKS FOR THE EXPERIENCE.  IF YOU CHANGE YOUR MIND ENTER <1>";EN:IF E
N=1GOTO260
530 CLS:END
540 REM ***  CONSTRUCT HEXAGRAM LINES
550 A=6:FORJ=115TO66STEP-1:SET(J,K):NEXTJ
560 FORI=55TO6STEP-1:SET(I,K):NEXTI:RETURN
580 A=9:FORI=115TO6STEP-1:SET(I,K):NEXTI
590 RETURN
600 READK,Y:Z(Y)=A:RETURN
610 DATA36,1,29,2,22,3,15,4,8,5,1,6
```

MicroQuote

Your personal computer becomes a window on Wall Street.

MicroNET, the personal computer service of CompuServe, now offers MicroQuote, a comprehensive securities information system.

With MicroQuote you can gain information from a data bank of over 32,000 stocks, bonds and options from the New York, American, OTC and major regional markets plus Chicago options. MicroQuote contains price and volume data from January, 1974 with cumulative adjustment factors and dividend information from January, 1968.

You can determine indicated annual dividends, earnings per share, shares outstanding, BETA factors, open interest on options and amount outstanding on debt issues. MicroQuote can provide issue histories on a daily, weekly or monthly basis and even performs certain statistical analyses on the data. It's a vital tool for any investor.

It's just part of the MicroNET service

MicroNET also allows error-free downloading of software via the new software exchange and executive programs (now available for the TRS-80,® Apple II® and CP/M® systems). It also provides electronic mail service and can be accessed with a 300 baud modem via local phone calls in more than 175 U.S. cities. Write for full details on how your microcomputer can control one of the nation's largest and most sophisticated time-sharing computer centers for about 8 cents a minute!

TRS-80 is a registered trademark of Tandy Corporation
Apple II is a registered trademark of Apple Computer, Inc.
CP/M is a registered trademark of Digital Research

Regional distributors and local dealers wanted. Inquire to Dept. R

Software authors: MicroNET seeks to license quality programs for software exchange. Write to Dept. S



Mail to: **CompuServe**

Dept: B
Personal Computing Division
5000 Arlington Centre Blvd.
Columbus, Ohio 43220

Computing the *I Ching* with a TRS-80

Dr Edwin Dethlefsen
Anthropology Dept
College of William and Mary
Williamsburg VA 23185

Today most people think of the *I Ching* (or *Yi Ching* or *Yi King*) as a kind of oriental fortune-telling game. Actually, it goes back long before the time of Christ. It was begun in the Chou dynasty in the 12th century BC and was mostly completed in its present form about 900 years later. Even Confucius is supposed to have tried it. It originated as a philosophical manual and set of exercises for looking at one's world and its problems in the broadest and most perceptive possible way, a little like the idea of "making your own luck" while pretending that what happens is just "the breaks."

You can read and enjoy the *I Ching* just like any book of rather esoteric oriental poetry, but that's really for the literary folks. Most of the college students who become involved with it attempt to use the book as a kind of reference for predicting the future or for figuring out solutions to such deep, personal problems as, "Does he *really* love me?", or, better yet, "What's the best way to make some money *fast*?"

I first became interested in the *I Ching* when I was a college student more than 30 years ago, because it was a terrific way to attract the attention of the opposite sex. Helping young ladies "cast" their fortunes was a foolproof way to get their undivided, personal attention.

Doing the *I Ching* thing is a very absorbing and satisfying pastime, once you understand how to play the game. Since there are several popular books written on the subject, I won't attempt to tell you all about it here, but I will talk about how easy it is to get a microcomputer to do the mechanical parts in a properly mystical fashion. I'll also say a little bit about how to consult this magical oracle. (It really is more magical than you might think, since the limits to its magical powers of knowledge are only determined by your imagination. Everyone I have ever seen use the *I Ching* has marvelled at its wondrous powers.)

Using the *I Ching*

Getting started with the *I Ching* is no big problem, once you understand that the whole thing is based on a six-position binary system. The two possible digits represent the *Yin* and the *Yang*, a Chinese representation of the concept of opposites (weak-strong, bad-good, dark-light, etc). In this case, the digits are simply line segments that are either continuous or broken in the middle, as shown in figure 1. These lines are the binary choices, just as we non-I-Chingers would use heads or tails.

In fact, determining the input for a *hexagram* is often done by casting Chinese coins and counting the heads and tails, but, if you will pardon my change of culture, this procedure is not exactly Kosher. I can remember once fruitlessly dashing all over the city of Berkeley, California, one lovely summer night, searching for the hard-to-get Chinese coins while accompanied by a particularly attractive young lady who was just dying for a chance to cast her fortune!

Ordinary Chinese fortune tellers use a fistful of marked, tortoiseshell wands, which, until the invention of the microcomputer, provided the only true path to the secret inner recesses of I Chingery. I have only seen one set of these wands outside a museum—in a Manhattan antique store where they were priced just a little higher than my TRS-80.

Now that I have leaked the word "hexagram," I'll have to explain that the *I Ching* is based upon all the possible combinations of six binary choices. That is to say, one must make six binary "casts" to produce a hexagram, which is then composed of the six lines determined by the casts. The hexagram, therefore, is one of sixty-four possible configurations. Each line has a binary value, as well as a value corresponding to its position, that is, the particular point in the hexagram at which that line was cast. Let's look at a sample hexagram, shown in figure 2.

First, observe that there are six positions, each occupied either by a solid or by a broken line. But the hexagram, as well as being composed

Text continued on page 102

About the Author

Edwin S Dethlefsen is a professor of anthropology at the College of William and Mary. He bought a Radio Shack TRS-80 computer in January 1979 with no definite purpose in mind, but he soon found a use for it in cataloging archaeological statistical data. He also uses his computer to write and record correspondence, to organize class notes and material, and to play games like the one presented here.

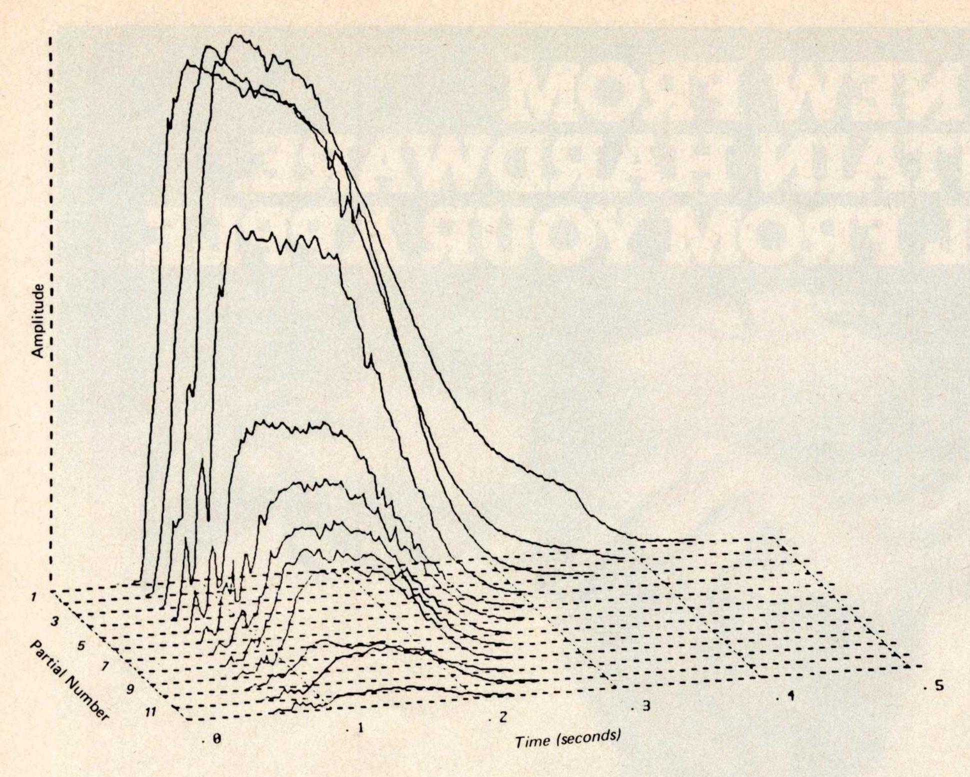


Figure 7a: *Computer analysis of a tone produced by a trumpet. This is a two-dimensional projection of a three-dimensional plot. Amplitudes of different harmonics present in the note have different attack and decay characteristics. (Figure reproduced from the* Computer Music Journal, *volume 2, number 2, 1978, page 1; used by permission).*

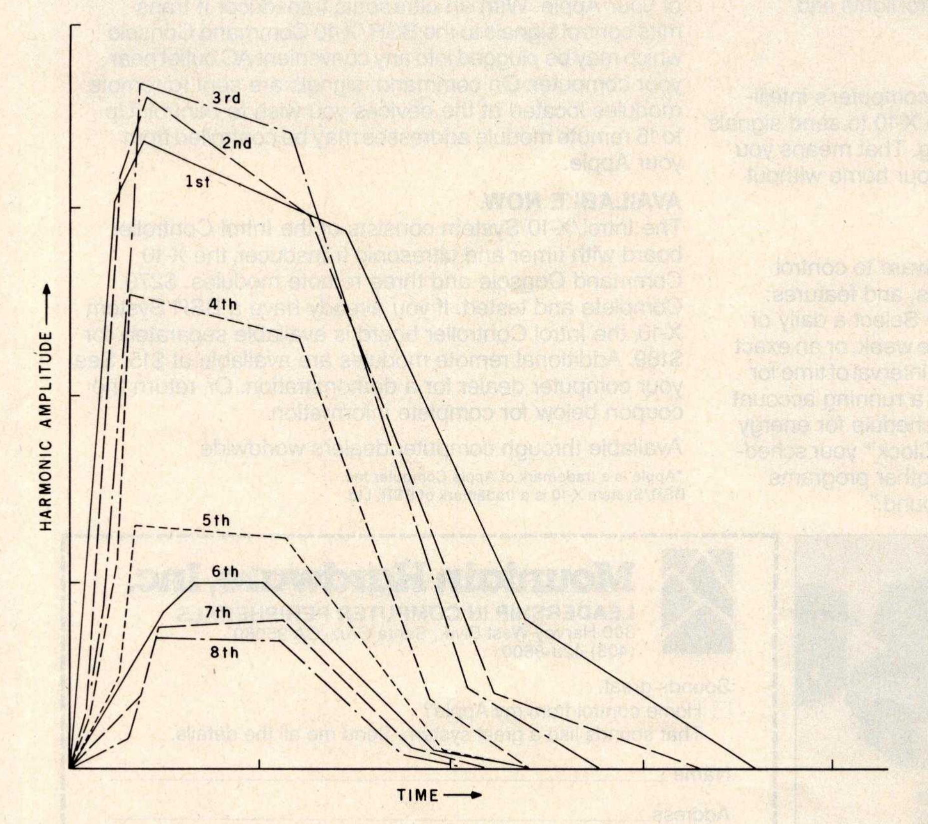


Figure 7b: *Simplified analysis of a trumpet note. The complex curves seen in figure 7a have been divided into relatively long line segments to reduce the amount of information necessary to specify the sound to the computer. The graph here is based on Moorer's straight-line-segment simplification of his trumpet analysis; see reference 3.*

groups of harmonics at different times.

Although all physical instruments have some degree of timbre variation during notes, much synthesized music tends to emphasize the timbre envelope because of the dramatic effect and because of the ease with which the effect may be created on an analog synthesizer.

Figure 7a shows a two-dimensional projection of a three-dimensional plot of a typical trumpet tone. The horizontal axis is time, the vertical axis is amplitude, and the perpendicular axis is frequency. Since trumpet tones contain only harmonic components, the plot becomes a family of curves, one for each significant harmonic. Each curve in figure 7a represents the amplitude envelope of the corresponding harmonic.

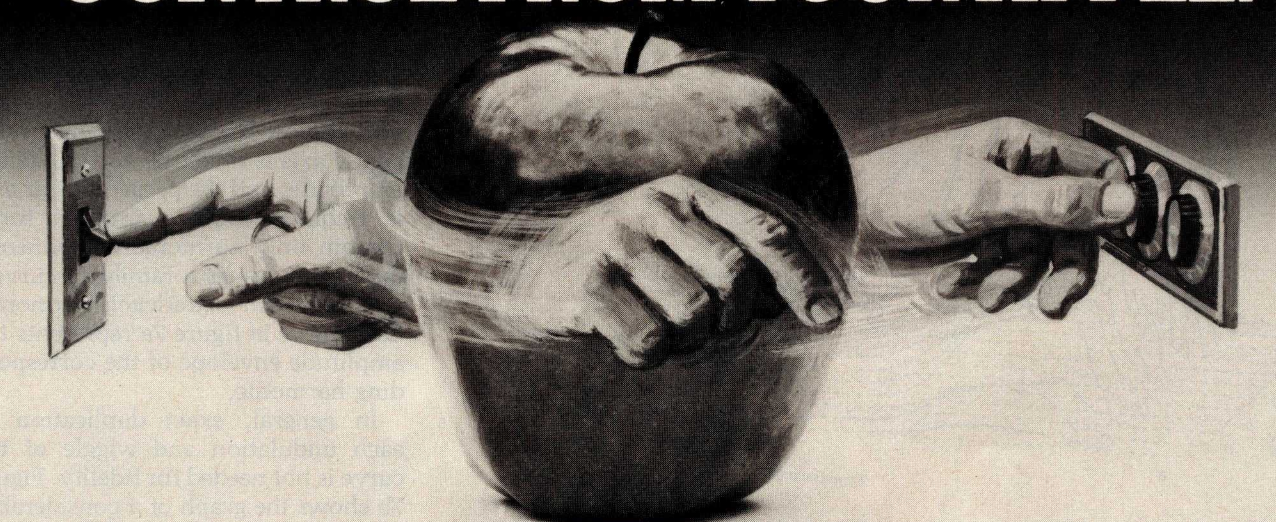
In general, exact duplication of each undulation and wiggle of the curve is not needed for fidelity. Figure 7b shows the graph of a considerably simplified version of the trumpet tone, which uses straight line segments to approximate the detailed computer analysis in figure 7a. Such an approximation greatly reduces the amount of information needed to specify the curves to a computer.

It should be noted that the analysis of a tone emitted by a particular musical instrument is completely valid only at the analyzed fundamental frequency and volume level (amplitude). Notes at other fundamental frequencies and amplitudes will give different analysis results. If the goal is accurate simulation of real musical instruments, several timbre envelopes will have to be available to cover the range of the instrument.

On an analog synthesizer, variable filters are used to smoothly vary the harmonic content of tones. A variable bandpass filter, for example, will emphasize harmonics falling between its upper and lower cutoff frequencies. By varying the filter parameters that determine these cutoff frequencies, the harmonic content of the filtered tone may be made to vary. By using a number of filters with different variations in parameters, it is possible, but difficult, to vary the harmonic content in any arbitrary manner. For sampled waveforms, we can use *digital filters* in the same manner, but the need for multiplication prevents the use of digital filters

Text continued on page 180

NEW FROM MOUNTAIN HARDWARE. CONTROL FROM YOUR APPLE.



INTROL/X-10.

COMPUTERIZE YOUR HOME.
The Introl/X-10 peripheral system for your Apple* Computer allows you to remotely control lights and electrical appliances in your home.

YOU'RE ALREADY WIRED.
Introl/X-10 operates by utilizing your computer's intelligence to command the BSR System X-10 to send signals over regular 110 volt household wiring. That means you can control any electrical device in your home without additional wiring.

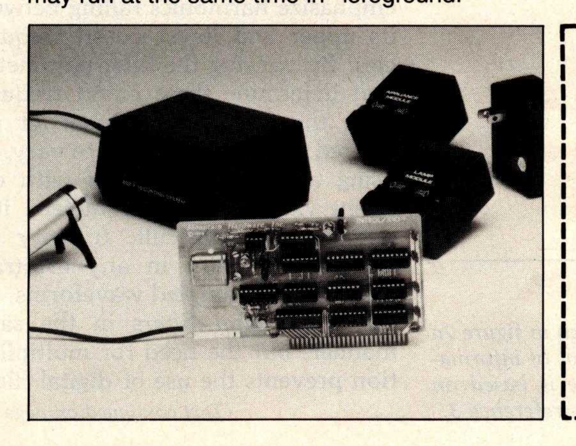
READY TO USE.
Introl/X-10 comes with complete software to control devices on pre-determined schedules, and features: • Control devices at a specific time. • Select a daily or weekly schedule. • Specify a day of the week, or an exact date for a particular event. • Specify an interval of time for an event. • Rate device wattages for a running account of power consumption during your schedule for energy management. • Used with our Apple Clock™ your schedules may run in "background" while other programs may run at the same time in "foreground."

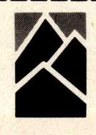
EVERYTHING YOU NEED.
The Introl Controller board plugs into a peripheral slot of your Apple. With an ultrasonic transducer it transmits control signals to the BSR/X-10 Command Console which may be plugged into any convenient AC outlet near your computer. On command, signals are sent to remote modules located at the devices you wish to control. Up to 16 remote module addresses may be controlled from your Apple.

AVAILABLE NOW.
The Introl/X-10 System consists of the Introl Controller board with timer and ultrasonic transducer, the X-10 Command Console and three remote modules. $279. Complete and tested. If you already have a BSR System X-10, the Introl Controller board is available separately for $189. Additional remote modules are available at $15. See your computer dealer for a demonstration. Or, return the coupon below for complete information.

Available through computer dealers worldwide

*Apple is a trademark of Apple Computer Inc.
BSR/System X-10 is a trademark of BSR, Ltd.





Mountain Hardware, Inc.
LEADERSHIP IN COMPUTER PERIPHERALS
300 Harvey West Blvd., Santa Cruz, CA 95060
(408) 429-8600

Sounds great.
☐ Home control from my Apple?
That sounds like a great system. Send me all the details.

Name ______________________

Address ______________________

City ____________ State ________ Zip ________

Phone ______________________

Circle 57 on inquiry card.

forms a very important contribution to the overall "timbre impression" of a note. A convincing demonstration is to play a recording of a piano backwards. The result is an organ-like sound that bears little resemblance to a piano. Any serious music-synthesis system should have some provision for nonrectangular envelopes.

The obvious way of obtaining a varying amplitude envelope from our system is to multiply the samples obtained from waveform tables by a variable-amplitude factor which itself may be obtained from an *envelope shape table*. Although simple in concept, this multiplication is not practical for real-time operation on a microprocessor. A crude application of this method involves restricting the multiplier to powers of 2, but the resulting 6 dB amplitude steps are widely spaced.

Another method involves using a device called a *multiplying digital-to-analog converter*, connected to the microcomputer. A multiplying D/A converter contains *two* data registers and produces an output voltage proportional to the *product* of the numbers stored in the registers. The multiplying D/A converter can be viewed as a regular D/A converter followed by a digital volume control. The analog circuitry of a multiplying D/A converter is far simpler than that of a digital multiplier and costs roughly twice as much as a standard D/A converter. The primary problem with the multiplying D/A converter is that it can provide an amplitude envelope for only one tone; simultaneous multiple tones receive the same envelope. Use of the multiplying unit also compromises our concept of the D/A converter as a completely general sound-output device.

A third method of generating varying amplitudes is to use a *sequence* of waveform tables, each table having a slightly different amplitude, to approximate an envelope. Since the tables are computed in advance, multiplication time is of no consequence. This technique was first proposed by my associates, Frank Covitz and Cliff Ashcraft, but it was deemed impractical on the grounds that any reasonable approximation would require too much memory.

Frank and Cliff went ahead and tried it anyway. The results, even using moderate amounts of memory, were much better than expected.

During the interval that a note is to be sounded, the amplitude envelope is determined by selecting waveform samples from various tables in succession. Each table contains samples of the same waveform, but stored with the amplitude differing from the samples in the other tables.

An undesirable effect might occur, however, if the amplitude steps between the samples from different tables are distinctly audible. This has not been a problem, for the following reason.

The relative difference between two amplitudes must exceed a certain threshold to be audible to human ears. When we consider that we can store thirty-two waveform tables in 8 K bytes of memory, we see that for notes of moderate duration (about 1/4 second) and of moderate frequency (around 250 Hz), waveform samples are taken from a new table every second cycle of the wave. This rate is fast enough to obviate any audible amplitude stepping. Although the memory usage is high, the decreasing cost of memory makes the method reasonable in many circumstances.

[**Editor's Note:** *For more information about the threshold of audibility for changes in musical dynamics, see the article "Musical Dynamics" by Blake R Patterson in the November 1974 issue of* Scientific American, *pages 78 thru 95 . . .* **RSS**]

Timbre Envelopes

There is still something missing in tones synthesized with a constant waveform, even when we employ a varying amplitude envelope. The harmonic content of most musical tones is not static during the time a note sounds, but rather changes considerably.

Some examples follow. The higher harmonics of a piano tone decay faster than the lower harmonics. This is due to viscous losses in the string and better radiation coupling to the air (for the higher harmonics). In a trumpet note, the high harmonics take a while to build up during the attack phase of the note. The use of a hat mute to impart the distinctive "wah-wah" effect to a trombone creates a resonant cavity around the instrument's bell. Moving the mute changes the resonant frequency of the cavity and thus emphasizes different



Please send your free software catalog.

(Check which software is of particular interest)

☐ C COMPILER. Optimized native code for VAX 11/780, PDP-11, LSI-11, Z80, 8085, 8080. Full C language as defined in Kernighan and Ritchie, with comprehensive portable library. Cross compilers available. Runs under VMS, IAS, RSX-11D, RSX-11M, RSTS/E, RT-11, UNIX, Idris, CDOS, CP/M. From $500.

☐ IDRIS OPERATING SYSTEM. System calls and file system identical to UNIX V6, including pipelines. Utilities include shell, editor, assembler, loader, archiver, compare, copy, grep, etc., plus system utilities for file system maintenance. Runs on LSI-11, PDP-11. From $1000.

☐ PASCAL COMPILER. Optimized native code for VAX 11/780, PDP-11, LSI-11, Z80, 8085, 8080. Full Pascal language as defined in Jensen and Wirth, with standard library. Includes C compiler and portable library, permitting intermixed C and Pascal. Cross compilers available. Runs under VMS, IAS, RSX-11D, RSX-11M, RSTS/E, RT-11, UNIX, Idris, CDOS, CP/M. From $750.

Name________________________

Company_____________________

Street_______________________

City__________ State________ Zip________

Idris is a trademark of Whitesmiths Ltd.
UNIX is a trademark of Bell Laboratories.
CP/M is a trademark of Digital Research Co.

VMS, RSX-11, RT-11, RSTS/E, VAX, PDP-11, LSI-11 are trademarks of Digital Equipment Corporation.

Whitesmiths, Ltd.

Software for grownups.

(212) 799-1200

P.O.B. 1132 Ansonia Station, New York, N.Y. 10023

(J index) stepping through the harmonics.

As the program is written, the harmonic amplitudes must be such that the maximum positive or negative waveform peak does not exceed the −128 to +127 range of the table entries. An improved program would automatically *normalize* the computed waveform for maximum utilization of 8-bit table entries. Since the tables have to be filled only once (either when the music is coded or immediately before performance), the slow speed of an interpreted BASIC program is adequate to get the job done.

One other possibility is using an A/D converter to digitize the waveform of a real musical instrument. The trick to doing this successfully is to get exactly one cycle of the waveform into the table. This in turn requires an accurate knowledge of the pitch of the digitized note and a very good interpolation routine. Although the process can be practical, simply storing and reproducing a single cycle of the waveform does not necessarily duplicate the complete timbre of the instrument, as will be shown later.

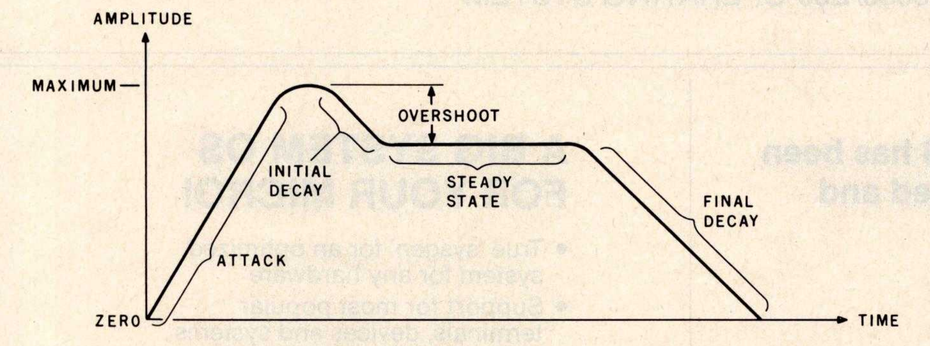


Figure 6: *Amplitude envelope for a typical musical sound. This exhibits in graphic form how fast a given tone builds up, continues to sound, and then dies away. Terms for various parts of the envelope are shown.*

It should be mentioned here that table scanning is not a perfectly general method of generating tones because only *periodic* (harmonic) waveforms may be produced. Some tones, notably those from bells, are made up of sine-wave components (overtones) that are not harmonics of any well-defined fundamental. The waveforms of such tones are constantly changing, to the point that there *is* no identifiable period. As a result, such sounds cannot be generated by scanning a single waveform table. As a practical matter though, such tones may be approximated by building a waveform table having only high-order, prime-number harmonics (such as 7, 11, 13) of a low-frequency, zero-amplitude fundamental.

Amplitude Envelopes

Although the ability to synthesize any periodic waveform offers a great deal of variety in timbre, it is not the last word. In experimenting with a music system based only upon the principles that have been discussed so far, we discover that all of the different waveforms sound more or less like an organ; just different stops. We will never find a mere waveform that sounds like a piano, or a plucked string, or a horn. One of the missing ingredients is called an *amplitude envelope*, which is involved with the attack (build-up) and decay of notes.

Figure 6 presents a typical amplitude envelope along with terms for the various parts. Using a plucked string as an example, we have a rapid (but not instantaneous) attack as the string is released, no overshoot or steady state, and a slow decay as the vibrations damp out. In contrast, a pipe organ has both a rapid attack and decay, but a level, steady state in between. An electronic organ or a music program based on simple waveform-table scanning has an instantaneous attack and decay and a level, steady state. We call this a "rectangular envelope."

It turns out that the shape and duration of the amplitude envelope

Listing 3: *A BASIC program that calculates and prints out values to fill a waveform-sample table. The user must specify the number of harmonics desired in the tone (ten is a typical number). Then the user must type in amplitude and phase information for each harmonic. This program produces only printed output, but it could just as well place the waveform samples directly in the memory locations reserved for the tables, using POKE statements.*

```
5    REM: FOURIER SERIES WAVEFORM TABLE FILLER
10   REM: N IS HIGHEST HARMONIC
20   REM: A IS AMPLITUDE ARRAY
30   REM: P IS PHASE ARRAY
35   PRINT "WHAT IS HIGHEST DESIRED HARMONIC";
40   INPUT N
45   DIM A(N), P(N)
50   PRINT "INPUT AMPLITUDE ARRAY"
55   FOR I = 1 TO N
60   INPUT A(I)
65   NEXT I
70   PRINT "INPUT PHASE ARRAY"
75   FOR I = 1 TO N
80   INPUT P(I)
85   NEXT I
90   REM: CALCULATE AND PRINT WAVEFORM TABLE
100  FOR I = 0 TO 255
110  W = 0
120  FOR J = 1 TO N
130  W = W + A(J) * COS (0.02454369 * I * J + P(J) )
140  NEXT J
150  PRINT I, INT(127*W)
160  NEXT I
170  STOP
999  END
```

Hz, somewhere between the notes B0 and C1. If middle C (C4) is desired instead, the increment value would be set to about 8.37 in order to produce 261 Hz. Now, since the waveform was drawn by hand, it could have some very high harmonics in its shape, possibly as high as the 128th harmonic (one half the table length).

For argument, let's say that the 40th harmonic has a significant amplitude in the drawn shape. The 40th harmonic of 261 Hz is 10.44 kHz, which is much more than one half of the 8 kHz sample rate. The result is that the 40th harmonic will *alias*, and for this example will actually sound at 2.44 kHz. Thus, not only will a digital-sampling system fail to reproduce frequencies above one half of the sample rate, but it will severely distort any attempts to do so. As a result, waveforms used in the tables must have a controlled harmonic content in order to avoid such alias distortion.

Actually, it is quite desirable to fill the tables by directly specifying the harmonic content. One advantage is that there is a direct, although sometimes subtle, correlation between harmonic content and timbre. Another advantage is that alias distortion may be precisely predicted and therefore avoided. The rule is that the *highest* nonzero harmonic of the *highest* note played using the table must not exceed one half of the sample frequency.

Writing a program to fill waveform tables from harmonic specifications is actually quite simple, particularly if a high-level language is used. In listing 3 is shown a BASIC program that will print out a 256-byte waveform table, once it has been given harmonic amplitude and phase arrays. The program could just as easily POKE the values into memory for use by the machine-language table-scanner program.

In the program of listing 3, the variable N is the highest harmonic number to be included; A is the amplitude array, which contains amplitude factors between 0 and 1.0; and P is the phase array, which contains phase angles between 0 and 6.28 radians, relative to a cosine wave. The program structure is simply two nested loops with the outer loop (I index) stepping through the waveform table entries and the inner loop

all that is required is a normal double-precision addition operation on the integer and fractional parts of the pointer. Overflow from the integer part of the result is simply ignored. Ignoring the overflow causes the lookup routine to wrap around the table, conceptually bending the table into a circle, as mentioned earlier. Using a 1-byte fractional component gives a tone-frequency accuracy of 0.12 Hz when the sample rate is 8 kHz, which is accurate enough for musical applications.

A segment of 6502 assembler code for adding the increment to the pointer and looking up in the waveform table is shown in listing 2. Since all operands are in memory (they should be in page 0 for maximum speed), any number of tables and pointers may be manipulated concurrently for simultaneous tones. Total execution time for the instructions is only 23μs for a 1 mHz processor clock rate, so the technique seems promising for real-time synthesis of several simultaneous tones. The clear-carry instruction normally required before an addition has been omitted, since its effect on the tone is very small (it will be sharp by a maximum of 0.12 Hz), and 2 μs are saved by the omission.

Other microprocessors can certainly perform these operations too, although all other 8-bit processors I have studied are significantly slower than the 6502, when straightforward programming techniques are used. The problem is that other comparable processors have neither indirect addressing through memory nor enough index registers to hold several pointers at once. Thus, the pointer must be loaded into a register before the table-lookup operation is done, which is a time-consuming operation. (Z80 programmers could use both register sets and probably have enough registers.)

One possibility for speeding up execution which involves cheating a little is to simulate indirect addressing by using the address bytes of a load instruction as the page and integer part of the table pointer and keeping the fractional part elsewhere. Although this is program self-modification, it is completely crash-proof and self-initializing. In the case of a system stored in read-only memory, the table-lookup code would have to be copied to programmable memory and executed there.

So far we have a method of producing single tones of specified frequency and waveform (amplitude control will be discussed later), but the goal is generation of at least three simultaneous tones. Fortunately, this is very simple; we simply maintain a separate pointer and increment for each tone, access the waveform tables individually, *add* the samples fetched from each, and send the *sum* to the D/A converter. There is no theoretical limit to the number of simultaneous tones, but there is a practical time limit to the manipulation that can be performed in the short period between samples.

Filling the Waveform Tables

Now that we have a mechanism for synthesizing any desired waveform at any desired fundamental frequency, the next problem is to fill the tables with desirable waveforms. Since anything can be put in the table, our first inclination is to draw waveforms by hand and enter empirically derived values into the table. This might even be a practical application of the graphics "doodle" programs that are so common, or a good application for a graphic digitizer.

When we actually try it, however, drawing waveforms turns out to be an unsatisfactory method of filling tables. One problem is that there is very little obvious relationship between the drawn shape and the resulting sound timbre. For example, if a shape has been drawn and it generates a sound that is close to what we want, there is no way to know what should be changed to make the sound timbre more like what is desired. In practice, experimenting with drawn shapes is little better than listening to the results produced by a random-number generator and saving the "best ones" for later use.

A more severe problem in using drawn waveforms is *alias distortion*, which occurs when the waveform table is scanned with an increment greater than 1, which is the usual case. For example, with a 256-byte table and an 8 kHz sample rate, a table increment of 1 will produce a fundamental frequency of about 31

Listing 2: *A segment of 6502 code that increments the waveform-table pointer and looks up entries in the waveform table to be sent to the D/A converter. All operands are assumed to be stored in page 0 of memory for maximum speed; any number of tables and pointers may be manipulated concurrently for producing multiple, simultaneous tones. Execution times are given in microseconds for a 1 MHz clock.*

Symbol	Operation	Comments	Execution Time
LOOKUP:	LDA PF	; ADD FRACTIONAL PART OF	3
	ADC IF	; INCREMENT TO FRACTIONAL	3
	STA PF	; PART OF POINTER.	3
	LDA PI	; ADD INTEGER PART OF	3
	ADC II	; INCREMENT TO INTEGER PART	3
	STA PI	; OF POINTER WITH CARRY.	3
	LDA (PP), Y	; PERFORM THE TABLE LOOKUP,	5
		; ASSUME Y=0, REGISTER A	
		; CONTAINS TABLE ENTRY WHEN DONE.	
		Total Execution Time	23

difference if n is large. In general, complex waveforms will incur more interpolation noise than simple waveforms. If waveform complexity is measured by giving the highest dominant harmonic number in the waveform, doubling this number will increase the noise level by 6 dB.

A 256-entry table containing a simple sine wave will have a signal-to-interpolation-noise ratio of approximately 42 dB with no interpolation and 83 dB when using linear interpolation. The corresponding figures for a typical complex waveform having sixteen harmonics would be 27 dB and 52 dB. Clearly, interpolation noise is a limiting factor when short tables and zero-order interpolation is used.

While scanning tables using indices containing a fractional component may seem complex, it is actually very simple on a microcomputer if things are set up correctly. In particular, the waveform tables are made 256 bytes long, which simplifies things considerably. Figure 5 shows how table scanning can be handled on a 6502 microprocessor.

The table pointer is actually a string of 3 bytes in memory. (The bytes are shown in natural order here, but in the microprocessor they are stored in reverse order.) The most significant byte contains the memory-page number of the waveform being scanned. Normally this value is constant during the scanning, but it can be easily changed for reference to a different table. The middle byte contains the integer part of the pointer value, and the rightmost byte contains the fractional part. A simple indirect register-load operation using the left 2 bytes of the table pointer is all that is required to perform the table lookup with no interpolation.

The table increment is a 2-byte value with the integer part on the left and the fractional part on the right. To add the increment to the pointer,

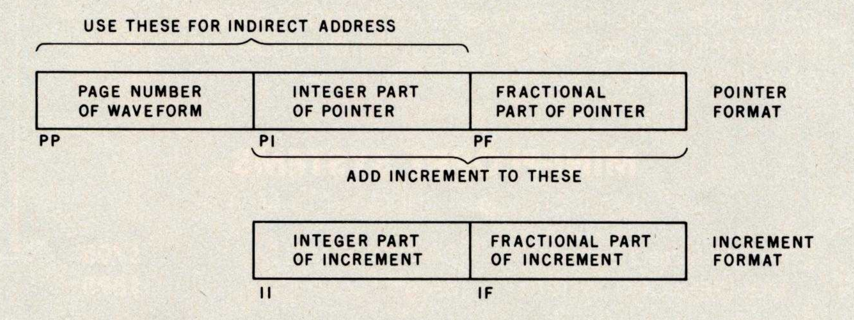


Figure 5: *Method employed to scan the waveform-sample tables on the 6502 microprocessor. Each waveform table is made to be 256 bytes long, one page of memory. The pointer to the table entries is 3 bytes long; it is shown here in natural order, but is stored in memory in reverse order. Indirect addressing is used. Interpolation between table entries is not performed (see text). The fractional component of the pointer is not used in addressing the table. The 6502 assembler-language code for accessing table entries is shown in listing 2.*

tion for the sine function used in high-level languages is unsuitable. The solution is to use a *sine table* stored somewhere in memory.

Fortunately, table lookup is a very fast operation on most microprocessors, and doubly so on the 6502 with its indirect addressing modes. Because of its smoothly rising ramp, sample values from the sawtooth calculation can be used as an *index* into the sine table; the values retrieved from the table are the output samples that are sent to the D/A converter. In essence, the table is being repeatedly *scanned* to produce a periodic waveform (which actually can be any waveform) for the D/A converter. This *table-scanning* concept is the key to D/A converter-based microcomputer music.

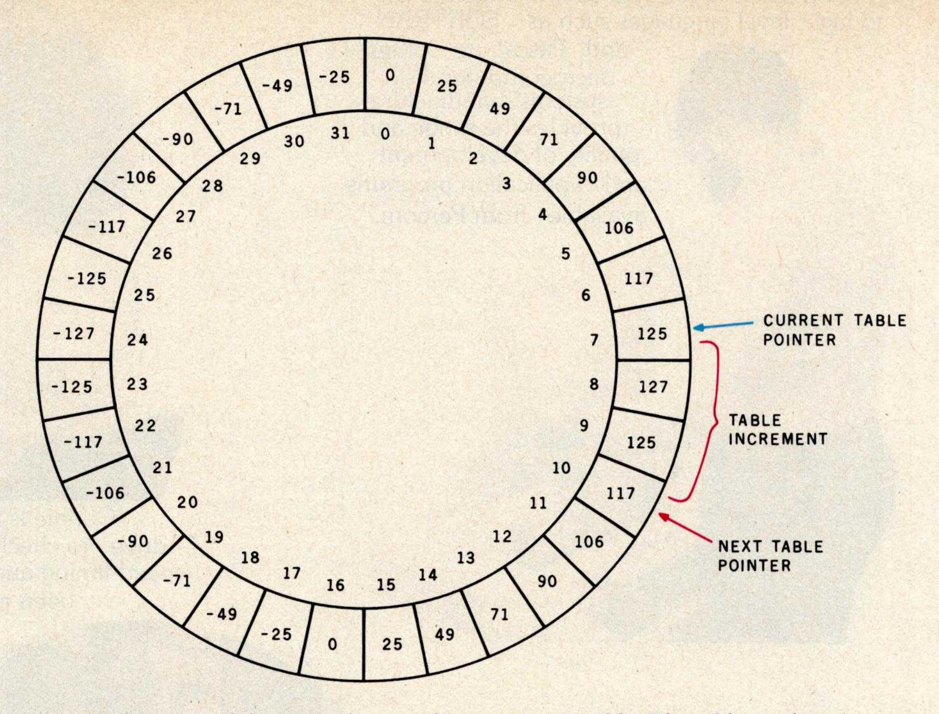


Figure 4: *Conceptual diagram of a waveform-scanning table. The table, in this case containing thirty-two waveform samples, is scanned in such a manner that the end of the table seems to be contiguous with the beginning. The table pointer indicates the value that is currently being sent to the D/A converter. During each sample period, a table-increment value is added to the table-pointer value, yielding a new pointer position further around the table.*

Scanning Waveform Tables

Figure 4 illustrates the waveform-table-scanning concept in more detail. Since a periodic, repeating waveform is to be generated, one cycle of the waveform is stored in the table. The scanning is done such that the end of the table seems to be contiguous with the beginning; thus the linear table in memory is conceptually bent into a circle. A *table pointer*, represented by an arrow in the diagram of figure 4, points to the current table entry that is being sent to the D/A converter. During each sample period a *table increment* is added to the pointer value. This yields a new pointer position further around the circle, which is used to fetch a new waveform sample for the D/A converter.

If the sample period remains constant, which it always must when multiple sounds are synthesized simultaneously, control over fundamental frequency is exercised solely by changing the table increment value. When the increment is greater than 1, the scanning process will skip samples in the table. While this may seem to reduce the accuracy of waveform reproduction, there is no audible effect if the tabulated waveform conforms to certain restrictions that will be discussed later. Keep in mind the sampling distortion results discussed previously.

When the pointer and increment values are restricted to integers, the result is a severely limited variety of frequencies, unless the waveform table is very large. To make use of tables of practical size, such as 256 entries, and to allow a wide range of possible frequencies, it is necessary to allow for the case of the pointer and the increment taking on values with *fractional* parts. The scanning procedure is the same when fractional parts are present, but a problem arises when the "78.1854th table entry" is to be fetched.

The logical thing to do is to interpolate between the values of the 78th and 79th table entries to determine the correct value to be sent to the D/A converter. The easiest method of interpolation, linear interpolation, is certainly an improvement over no interpolation at all, but it is not perfect. Higher order interpolation (quadratic, cubic, etc) is needed for really good results. Sinc-function interpolation using the *sin(x)/x* curve is required for theoretically perfect sampled-waveform interpolation. The result of imperfect interpolation is a background-noise level that is present regardless of the precision of the D/A converter used to reproduce the waveform. Noise from this source is termed *interpolation noise*.

The problem with interpolation is that multiplication and division operations are required. Even the simplest linear-interpolation scheme requires two table-lookup operations, one multiplication, and one addition; and therefore such a scheme is not practical in a real-time synthesis program for a microcomputer. In the software described later in this article, the fractional part of the pointer is simply ignored when table lookup is performed, which is equivalent to truncating the pointer to the next lower integer value. It is important to note that rounding the pointer (to the closest integer value, up or down), rather than truncating it, has no audible effect on the interpolation-noise level, contrary to some published data. Rounding merely shifts the phase of the reproduced waveform slightly.

The amount of interpolation noise depends on the length of the waveform-sample table, the interpolation algorithm, and the properties of the actual waveform being scanned. In general, doubling the length of the table will reduce interpolation noise by 6 dB, a substantial but not dramatic change. If the noise level from truncation (zero-order interpolation) is $-n$ decibels, then the noise level from i-th order polynomial interpolation is $-(i+1)n$ decibels, a dramatic

"Percom Sells More Microcomputer Disk Systems Than Any Other Peripherals Manufacturer. I'd like to show you why."

"Percom has been manufacturing mini-disk storage systems for microcomputers since 1977 when we introduced the 35-track, single-drive LFD-400™. Now we produce 1-, 2- and 3-drive systems in 40- and 77-track versions, a multi-density MEGABASE™ system and a host of accessories and software.

"Volume not only means experience in critical production and testing operations, it also means we can offer superior design features, extra testing and qualified backup support at very competitive prices.

"I know of no other microcomputer disk system manufacturer who even begins to offer the broad spectrum of disk equipment and programs available from Percom."

"So before you buy a mini-disk system for your 6800, 6809 or TRS-80* computer, take a good look at what the people at Percom have to offer."

Harold Mauch
President, Percom Data Company

Percom disk systems start at only $399.00. Disk systems and other quality Percom products are available at computer dealers nationwide. **Call toll-free, 1-800-527-1592, for the locations of dealers in your area, or to order direct.**



PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
TM trademark of Percom Data Company, Inc.
*trademark of Tandy Radio Shack Corporation which has no relationship to Percom Data Company.

Circle 44 on inquiry card.

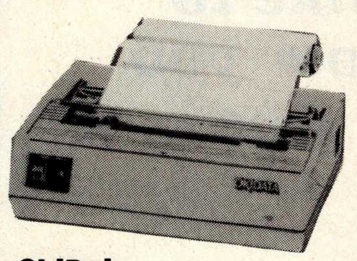


free freight!



MICROWORLD®

New Products



OkiData
MicroLine 80

Compact, lightweight 80 cps line printer; 9X7 matrix . . . friction, pin or tractor feed! 132 column w/compressed print, graphics, and more!

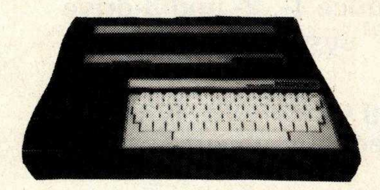
Call for Price!



Atari 800

The "timeless" home computer system: expandable memory, advanced components, comprehensive software library.

Call for Price!



Mattel Intellivision

Transforms your home TV into a family center for games, entertainment, education and household management. Separate master and keyboard components.

Call for Price!

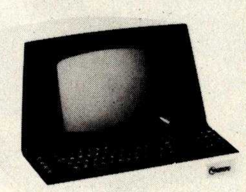
Prices subject to change without notice; products subject to availability.

MicroWorld® Attacks Inflation With Free Freight, Low Pricing . . .

MicroWorld introduces the most attractive mail-order offer in the computer industry. *The nation's largest inventory*, plus our own automated order processing, allows us to pass along unrivaled cost savings. And now, as an additional measure to counter inflation, we offer *free freight* on any product featured on this page. We'll pay the surface freight on all pre-paid products in this ad, to any of 18,000 U.S. tariffed locations. *No handling charges*, add-on costs, insurance fees or credit card fees! Most items are *in stock* for fast delivery at exceptional discounts!

Call us before you buy anywhere else. Find out *their* total cost. Then compare with our low, freight-free price. Our industry-trained staff stands behind every order. We're *the source you can trust*. We grew up with the microelectronics revolution. We helped pioneer its growth. Our Free Freight program, our attractive pricing, and off the-shelf delivery are our "thanks" to the thousands of satisfied computer users who made MicroWorld the *world's leading mail-order source* for microcomputers and peripherals!

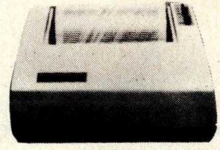
Soroc IQ 120



High quality, text editing terminal, 73-key board, built-in 2K RAM, RS232 interface.

$789

Comprint GP



Low priced electrostatic matrix printer, 225 cps; ideal for personal computers, or professional applications requiring second printer.

Call for Price!

TeleVideo 920B



Low-cost terminal loaded with features: full-function keyboard, 24X80 display, blink, reverse, self-test!

Call for Price!

Novation Cat

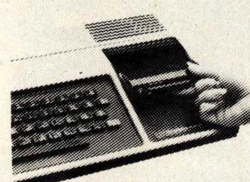


Acoustic modem with originate or answer modes over phone lines; compatible with any Bell 103 modem.

Call for price!

Call for Price!

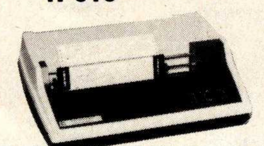
Texas Instruments
99/4 Home Computer



Superior sound, 16 colors, graphics; low price includes 13" color monitor, 16 bit CPU, TI BASIC and more!

Call for Price!

TI 810



150 cps, RS 232C tractors, 3" to 15" form width; bi-directional printing. An industry standard.

$1589

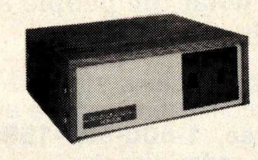
Zenith-Heath Data Systems
Z-89 All-in-One Computer



Two Z80 processors, mini-floppy drives, 25X80 display, 16K expandable to 48K!

Call for Price!

North Star Horizon



Quad- or double-density, while they last! Plus, hard disk drives for expansive storage requirements.

Call for Price!

TOLL-FREE 1-800-528-1418

1425 W. 12 Pl. • Tempe, AZ 85281 • 602-894-1193

Listing 1: *A routine written in assembler language for the 6502 microprocessor. This routine generates a sawtooth waveform, such as the one shown in figure 1.*

```
LOOP: CLC        ;CLEAR CARRY FLAG
      ADC FREQ   ;ADD FREQ TO ACC
      STA DAC    ;SEND RESULT TO D/A
      JMP LOOP   ;LOOP FOREVER
```

code in listing 1 will generate it. In essence, the accumulator (register A) is the sawtooth generation register, and the content of the memory location FREQ determines the frequency of repetition of the sawtooth waveform. For example, assume that the accumulator initially contains the value 0 and that FREQ contains a 1. Each time around the loop, the accumulator will be incremented so it will contain successive values (in two's complement arithmetic) of 0, +1, +2, . . ., +125, +126, +127, −128, −127, −126, . . ., −2, −1, 0, +1, +2, etc. The incrementing represents the smooth upward ramp of the waveform while the overflow from +127 to −128 represents the retrace or "flyback" of the waveform, the point where the signal drops to its extreme negative value. If FREQ contained a 2, then the ramp-flyback sequence would be repeated twice as fast and result in a sawtooth of twice the frequency, provided that the loop time, which is the interval between samples from the D/A converter, remains constant.

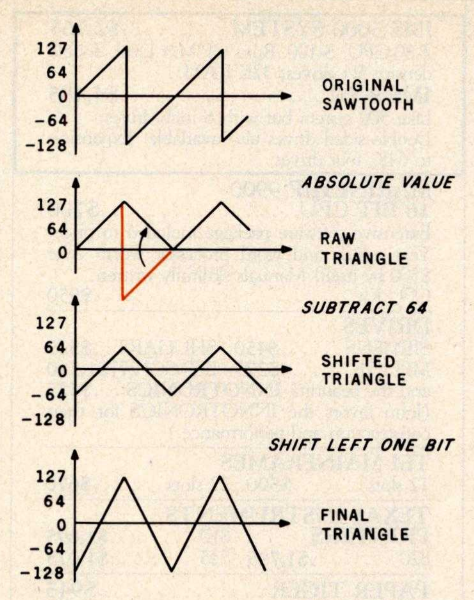


Figure 2: *Method for transforming samples of a sawtooth waveform into samples of a triangular waveform. First the absolute value of the contents of the accumulator is determined. A constant value, 64, is subtracted from the accumulator. The remaining value is multiplied by 2; the multiplication is performed by the simple method of shifting the binary value one bit to the left.*

Figure 2 illustrates how the samples representing a sawtooth wave can be transformed into samples representing a *triangle* waveform. Although the appearance is similar, the sound is quite different. The sawtooth wave has a robust, somewhat buzzy sound while the triangle has a mellow, fluty timbre. The actual operations involved are simply finding the absolute value of the sawtooth samples, subtracting a constant, and multiplying by 2 (which is done by a simple register-shift operation).

A rectangular waveform is even easier to derive and is illustrated in figure 3. The sawtooth samples are simply compared to a *width* value; +127 is output if the samples are equal to or greater than the width, or −128 is output if the samples are less. The timbre of the rectangle varies from the kazoo sound of a square wave (width=0) to something very similar to a sawtooth (width=64) to a thin buzz (width=120).

The most interesting standard waveform, however, is the *sine* wave. Since complicated math cannot be used, the normal series approxima-

WIDTH VALUE
HIGH
LOW
127
64
0
−64
−128

Figure 3: *Derivation of a rectangular waveform. The value of samples from a sawtooth waveform are compared with some constant width value. If the sawtooth value is greater than or equal to the width value, the constant +127 is sent to the D/A converter. If the sawtooth value is less than the width value, the constant −128 is sent to the D/A converter.*

Circle 43 on inquiry card. →

HAZELTINE 1500,1510, 1520
Outstanding reliability. Clearest video image in this price range. **Excellent single & quantity pricing.** Also available with 50Hz. and French, German, Swedish characters.

IBM CRT 3101 .... $1,295
9 × 16 dot matrix. Selectric-like keyboard. Works on 50Hz., 220V.

TELEVIDEO Smart CRTs.
Many edit features and remote commands. B models have TTY-like keyboard; C models have Selectric-like keyboards.

912B	$745	912C	$780
920B	$795	920C	$850

SOROC IQ 120 .... $865

4116 RAM CHIPS $10
For Superbrain and TRS-80
IMS 16K Memory, 250 ns $340

CALIFORNIA COMPUTER SYSTEMS $270
16 K memory, Runs in 4MHZ systems without wait states. Excellent value.

Call on us for product sheets.
Dealer inquiry invited.
(Prices subject to change without notice.)

IMS 5000 SYSTEM $2,765
Z-80 CPU, S-100. Runs CP/M.® Dual, double density 5¼ drives, 32K RAM.
IMS 8000 .... $4,185
Like 500 system but with 8 inch drives. Double sided drives also available. Expansion to 64K, four drives.

MARINCHIP 9900 16 BIT CPU $700
Extensive software package included in price. Text editor and word processor worth over $500 by itself! Manuals skillfully written.
CPU Kit $550

DRIVES
SIEMENS ...... $450 SHUGART .. $525
MPI 851 .... $275 PER SCI 277 $1,210
and the beautiful INNOTRONICS ... $525
(John favors the INNOTRONICS for their construction and performance.)

TEI MAINFRAMES
12 slots .... $500 22 slots $670

TEXAS INSTRUMENTS PRINTERS
810 .... $1,695
820 .... $1,795 745 .... $1,075

PAPER TIGER $945
with graphics $100

TELETYPE MODEL 43 .... $985
with RS232 .... $1,085
220 v. transformer, installed $100
tractor feeder mechanism $100

DEC LA 34 .... $1,159
Plug compatible alternative to the hard-to-get TTY 43

DEC LA 35/36 UPGRADE $750
Increases baud rate to 1200. Micro-processor controlled. Many features including TOF, tabs and margins control. Quantity pricing.

NEC SPINWRITER 5510 .... $3,000
DIABLO 1640 KSR $3,195
These prices include tractor
QUME SPRINT 5/55 .... $3,380

CONTROLLERS
KONAN Hard disk, S-100 .... $1,550
TELETEK Double density $415
for 5¼ and 8 inch and single density
TARBELL Double density $385

MODEM: The CAT from Novation $179
Originate/answer

CODs accepted at no extra charge.
Shipping: $13 for light printers and CRTs.
Credit cards add 4%. NY residents add tax.

WE EXPORT
Overseas Callers:
Phone 212 448-6298
or TWX 710 588 2844
or Cable: OWENSASSOC

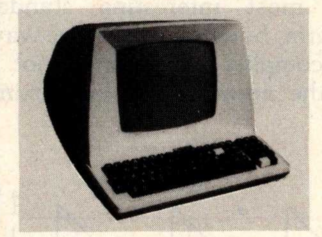
JOHN D. OWENS Associates, Inc.
12 Schubert Street
Staten Island, New York 10305
212 448-6283 • 212 448-6298

We Are Known for Our Prompt and Courteous Service!

We have no reader inquiry number.
Please call or write.

IMMEDIATE DELIVERY — FROM ORANGE MICRO



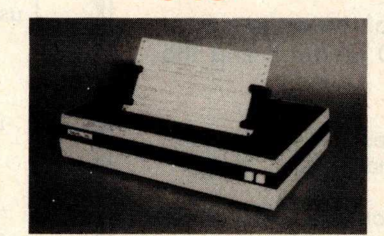


TELEVIDEO 912B
$769.00

STANDARD FEATURES (partial list)
- Reverse video, Underline, Blinking, Reduced
- Protected fields, Security Blank fields.
- Block or Conversational modes.
- Editing: Line or Character; Insert/Delete.
- Tab, Backtab; Columnar tab.
- 14 key numeric pad with return key.
- RS232 Printer Port

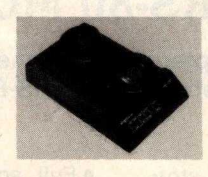
OPTIONAL:
- Deluxe Selectric® Keyboard: $75.00
- 2nd Page Memory: $80.00
- 11 Special function keys and 8 edit keys: $70.00

BASE 2 PRINTER
$549.00



FEATURES:
- 72, 80, 96, 120 or 132 Columns per line.
- Bi-directional, 7 dot matrix, impact.
- Graphics Capability.
- RS232, Centronics®, IEEE-488, 20 ma.
- 60 LPM / Fast feed.
- User Programmable Character Fonts.
- 16 Baud Rates — to 19,200.
- Expanded Characters.

OPTIONAL:
- 2K Memory Buffer: $50.00
- Tractor Mechanism: $50.00



Digicom Coupler
ORIGINATE
$179.00

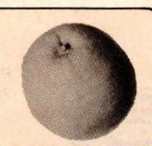
* with initial order of CRT or Printer

COMPARE QUALITY, FEATURES & DISCOUNT

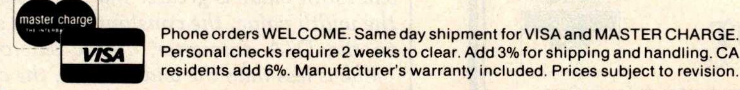
Products also available:
Qume, MPI, Lear Siegler, Cables, System Furniture
CALL OR WRITE FOR PRICES

CALL **(714) 630-3322**

Orange Micro



POST OFFICE BOX 2076
YORBA LINDA, CALIFORNIA 92686



Phone orders WELCOME. Same day shipment for VISA and MASTER CHARGE. Personal checks require 2 weeks to clear. Add 3% for shipping and handling. CA residents add 6%. Manufacturer's warranty included. Prices subject to revision.

Circle 41 on inquiry card.

will allow signal frequencies up to about 40% of the sample rate to be utilized. Thus a sample frequency of 50 kHz is suitable for covering the full audio range from 20 Hz to 20 kHz. Because the bandwidth of commercial frequency-modulated (FM) radio broadcasts is limited by the Federal Communications Commission (FCC) to 15 kHz, a 37 kHz sample rate is sufficient for FM broadcast applications. The 5 kHz bandwidth of amplitude-modulated (AM) radio requires a sample rate of at least 12.5 kHz. Speech can be understood and the speaker can be identified at sample rates down to 6 kHz.

Six bits of resolution in a D/A converter gives a 36 to 40 dB signal-to-noise ratio, which is comparable to that obtained with inexpensive, audio-cassette tape recorders that utilize DC record bias. Eight bits yields about 50 dB, which is in the range obtained with cassette machines costing $50 to $100. Ten bits of resolution gives a ratio of a little over 60 dB, which challenges the best home audio tape recorders and most phonograph disks. Professional mastering audio tape recorders have a difficult time keeping up with 12-bit D/A conversion, while 14- and 16-bit conversion must be listened to "live" for full effect since any analog recording device will add a considerable amount of noise (comparatively) to the signal.

Professionals working in the digital audio field generally consider 16-bit conversion at a 50 kHz sample rate to be a level of performance which need never be exceeded. A practical goal for microcomputer music synthesis is 12 bits at a 35 kHz sample rate, while half that rate would be ample to replace the function of home organs and pianos.

The programs, experiments, and results that will be discussed in the remainder of this article utilize 8-bit conversion at a rate of approximately 8 kHz. The effect is similar to that of listening to an AM car radio while speeding down the highway; and many people do the majority of their music listening in exactly this way. Actually, the quantization noise caused by 8-bit conversion is far less than the wind and road noise would be, but it is definitely audible.

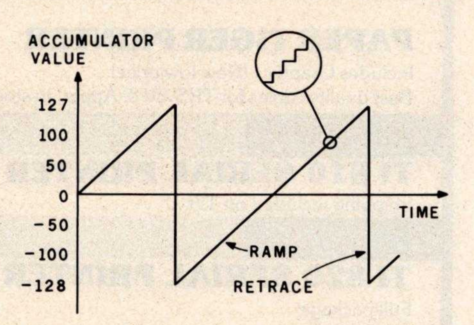


Figure 1: *Generation of a sawtooth waveform by software. Coordinate points along the waveform are generated by continuously adding a constant value, FREQ, to the accumulator (register A). The point values (samples) are sent to the D/A converter. A close-up circle demonstrates the inevitable stair-step quality of the curve reproduced from discrete samples. The 6502 assembler code to produce the sawtooth is shown in listing 1.*

Computing Waveform Samples

The real challenge in programming a D/A converter-based music system is of course computing the sound waveforms at a constant high speed. In particular, the calculations cannot use any multiplication or division operations (except by powers of 2) since only one such operation would require more time (100 to 150 μs for an 8-bit by 8-bit software multiply) than is available between samples. Actually, these restrictions apply only to a real-time music-playing program; sound waveform samples can also be computed using whatever mathematical operations are desired, and the samples can be saved on a disk as they are computed for later playback at a higher speed. Implementation of such non-real-time programs on personal-computer hardware will be the next step in improving microcomputer music synthesis quality and flexibility. More will be said about this possibility later.

There are a few waveforms that can be quickly computed without the need for multiplication and division. In fact, these turn out to be the same waveforms that are easy to generate by analog electrical circuits and are therefore used by most analog music synthesizers.

Perhaps the easiest is a *sawtooth* waveform, which is illustrated in figure 1; the 6502 assembler-language

Store Hours:
Mon - Fri 9-5:30
Ask for spec sheets

EXTRA SPECIAL PRICES & DELIVERY

Prices good until next Magazine issue

Domestic & International
Dealer Inquiries Invited

PAPER TIGER PRINTER

Includes Graphics (New low price) .... $ 949
Best quality cables for TRS-80 & Apple, In stock .... $ 39

TI 810 SERIAL PRINTER

Shipping included on TI's $1725

TI 820 SERIAL PRINTER

Full package $1995

QDP - 100 State Of The Art Reliable - Powerful

Complete - Up & Running Powered & Programmed

SUPERBRAIN COMPUTER

34K System $2995
64K System .... (CP/M & Basic included) .... Add $ 195

INTERTEC INTERTUBE TERMINAL

Checked and tested by us .... $ 797

ATARI-VIDEO COMPUTER SYSTEM 800

8K RAM, Basic, cassette recorder .... $ 895
Software & disk drives available

SINGLE BOARD COMPUTER

4MHZ Z-80, DBL sided, DBL density disk controller, 2716 prom burner, 2 parallel & 2 Ser. ports, real time clock, Bios for CPM 2.2, monitor in prom. This is absolutely the best board we have ever seen. It plus the Cen. Data 64K memory board gives you a complete system. One year parts & labor guarantee. (The best) .... $ 995

QDP 100

- ★ Two 8" double-sided, double density floppies
- ★ Monitor in Prom
- ★ 64K Memory
- ★ Int. 2716 Prom Burner
- ★ Four ports 2 Serial 2 Parallel
- ★ Full editing, smart CRT terminal
- ★ Disk Controller—up to 4 M.B.
- ★ Basic language included
- ★ S-100 Motherboard
- ★ CP/M 2.2 included
- ★ Real time clock
- ★ Z-80 4MHZ CPU

Quasar Computer System

Take a good look at the other machines on the market and compare. Our system is burned in, fully tested and assembled. The CPU Board is warranted for parts and labor for one year. Please call and we'll tell you more.
Stock to 30 days ARO $4795

CENTRAL DATA 4MHZ 64K

Dynamic Ram Bd. assembled & tested
16K — **$250** 32K — **$350** 48K — **$450** 64K — **$549**

TELETEK DBL. DENSITY, DBL. SIDED

Disk Controller Board .... $ 395
(The best) includes cable & source bios

MFE DBL. SIDED, DBL. DENSITY

Floppy disk drives (the best) .... $ 650
Using the Teletek Controller under CP/M, this drive will give you almost one megabyte per disk drive
Power supply for above .... $ 110

SOFTWARE

Integrated Accounting System G/L, A/P, A/R, P/R, INV. $1500
Selector III Data Base Management System .... $ 295
Wordstar by Micro Pro Word Processing System .... $ 445
C Basic .... $ 109

QUASAR FLOPPY SYSTEM

★ Two MFE DBL sided drives ★ Cable ★ Case & Power Supply assembled and tested .... **Special $1695**

QUASAR 2 MEG FLOPPY

Special - $2095

- ★ 2 MFE double sided drives
- ★ Teletek disk controller board
- ★ Power supply & cable
- ★ Wood cabinet
- ★ CP/M version 2.2 & bios
- ★ Assembled & tested

Checks, money orders accepted
Add $2.50 freight charges on orders under 10 lbs. Over 10 lbs. F.O.B. Cleveland

WE HONOR master charge THE INTERBANK CARD

QUASAR DATA PRODUCTS



25151 Mitchell Dr., No.Olmsted, Ohio 44070 (216)779-9387

Circle 39 on inquiry card.

at much higher frequencies than the desired signal. Thus, use of a low-pass filter (one that allows low frequencies through, but blocks high frequencies) will block the distortion and pass the signal distortion-free.

In fact, it turns out that if a signal of frequency f is to be reproduced using a sample rate of r, then the lowest frequency distortion component produced will have a frequency equal to the difference f-r. If the sound is complex and therefore contains many frequency components, the above applies to each component individually.

As long as the distortion components are higher in frequency than the desired signal components, the distortion components may be filtered out, although the closer the two sets of components approach each other in frequency the better the filter must be. The limit occurs when signal frequencies approach one half of the sample rate from below, since the distortion will then be approaching one half of the sample rate from above, and the filter has to be very good to separate the two. Any attempt to reproduce signal frequencies higher than this limit will result in the distortion getting through the filter and the signal being blocked!

In many ways this is a surprising result, since just two and a fraction sample points per cycle of a sine wave is a very coarse approximation indeed. Although this *frequency-domain* argument just given is the easiest to prove mathematically, most people have a hard time believing that a simple low-pass filter can convert such a mess, which may not even be the same shape for each cycle of the reproduced waveform, into a smooth, distortion-free sine wave. The best explanation is that when a system is expected to operate close to the one-half-sample-rate limit, the filter is *not* simple at all; it must be a multisection, sharp-cutoff design. All sharp-cutoff filters ring (oscillate in a usually undesired manner) when given a short signal pulse or the edge of a square wave, and the sharper they are, the longer they ring after being excited. It is this ringing, which is a damped sine wave, that fills in the gaps between samples with just the right curve to give a distortion-free output.

Quantization in *amplitude*, which is the result of roundoff error, is not so well behaved. Unfortunately, distortion from this source is spread evenly throughout the audio-frequency range, and as such is better characterized as noise. This *quantization noise* cannot be filtered out; it can only be reduced through the use of higher-resolution D/A converters.

Every D/A converter has a limit to the loudness or amplitude of the signals it can process; this limit is determined by the range of numeric values the D/A converter can handle. When we compare the amount of quantization noise with the loudest possible signal that the D/A converter can handle, we can determine a factor called the *dynamic range* or maximum *signal-to-noise ratio* (S/N ratio) of the system. The dynamic range is given in decibels (dB). Simply put, this ratio will be $6n+4$ dB for n greater than about 5, where n is the number of bits of resolution, including the sign bit, of the D/A or A/D converter in use. Real converters have errors of their own that introduce excess noise, so a handy rule of thumb is simply $6n$ dB.

Table scanning is the key to D/A-converter-based microcomputer music.

Note that this signal-to-noise ratio is greatest when the signal is on the verge of overload. Lesser signal amplitudes will degrade the ratio since the noise amplitude is essentially constant (at very low signal levels the noise amplitude will vary some, and at zero-signal amplitude the noise will be zero as well).

Recently, *exponential* D/A converters have become available which are claimed to be better suited for audio use. What actually happens is that an absolute *maximum* signal-to-noise ratio is traded for a ratio that is lower but more constant with varying signal amplitudes. When the D/A converter has 8 bits of precision, the resulting signal-to-noise ratio is rather low (35 dB), but when the precision is 12 bits or more, the exponential conversion method has important advantages.

Now let us consider practical matters, taking into account these frequency-response and noise-level properties of digital audio production. First, a practical low-pass filter

CENTRONICS PUTS IT IN PRINT: MORE PERFORMANCE FOR LOWER PRICES.

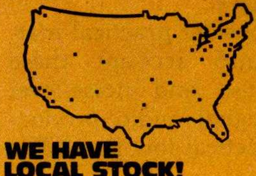
With the introduction of their new "Dash 9" Series of low-priced printers, newly improved and geared to meet your particular application needs, the small business can now enjoy Centronics' features and reliability. You can have high throughput for inventory control, full 132 column width for accounts receivable, versatile forms-handling capability for invoicing, payroll and statements, and exellent print quality for labels and listings. Plus, there's a new acoustic cover for more streamlined appearance and quieter operation in an office environment.

And like all Centronics printers, the "Dash 9" Series is fully supported by the largest worldwide service organization of any printer company.

See them at your nearest dealer who is backed by Hamilton/Avnet's Centronics inventory for immediate delivery.



CENTRONICS FROM HAMILTON/AVNET



World's largest local distributor with 40 locations stocking the world's finest lines of system components

SOUTHERN CALIFORNIA	
Avnet, L.A.	(213) 558-2345
Avnet, O.C.	(714) 754-6111
Hamilton, L.A.	(213) 558-2121
Hamilton, O.C.	(714) 641-4100
SOUTHWEST	
San Deigo	(714) 571-7510
Phoenix	(602) 275-7851
NORTHWEST	
San Francisco	(408) 743-3355
Portland	(503) 635-8831
Seattle	(206) 746-8750
ROCKY MOUNTAIN	
Salt Lake City	(801) 972-2800
Denver	(303) 779-9998
Albuquerque	(505) 765-1500
NORTH CENTRAL	
Chicago	(312) 678-6310
Minneapolis	(612) 941-3801
Milwaukee	(414) 784-4510
MID CENTRAL	
Kansas City	(913) 888-8900
St. Louis	(314) 344-1200
GREAT LAKES	
Cleveland	(216) 831-3500
Dayton	(513) 433-0610
Detroit	(313) 522-4700
SOUTH CENTRAL	
Dallas	(214) 661-8661
Houston	(713) 780-1771
Austin	(512) 837-8911
NORTHEAST	
Boston	(617) 273-7500
Syracuse	(315) 437-2641
Rochester	(716) 442-7820
METROPOLITAN	
Long Island	(516) 454-6060
Connecticut	(203) 762-0361
No. New Jersey	(201) 575-3390
MID ATLANTIC	
Baltimore	(301) 796-5000
So. New Jersey	(609) 424-0100
Raleigh	(919) 829-8030
SOUTHEAST CENTRAL	
Atlanta	(404) 448-0800
Huntsville	(205) 837-7210
SOUTHEAST	
St. Petersburg	(813) 576-3930
Miami	(305) 971-2900
CANADA	
Toronto	(416) 677-7432
Montreal	(514) 331-6443
Ottawa	(613) 226-1700
INTERNATIONAL	
Telex	66-4329
Telephone	(213) 558-2441
JAPAN	
Tokyo	(03) 662-9911

three-voice, square-wave synthesizer that utilizes a custom integrated circuit.

Audio D/A converters are by no means absent, however. Newtech has a 6-bit unit with a built-in power amplifier for S-100 and SS-50 bus systems. HUH Electronics has a simple 8-bit unit, the Petunia, for Commodore PET computers. My company, Micro Technology Unlimited, has two versions of a high-quality 8-bit D/A converter with filter and amplifer, one for the Commodore PET and the other for general application with any computer having an 8-bit parallel output port. Micro Music Inc has a similar unit supported by software for Apple II computers. The Ohio Scientific Challenger C4P and C8P models have an 8-bit exponential D/A converter built-in.

The fundamental problem with D/A synthesis of musical sounds is that the waveforms must be computed at a very high rate of speed for an acceptable frequency range in the reproduced sound. To do this in real time with currently available 8-bit microprocessors requires highly efficient programs and a few compromises as well. The results that have been obtained to date are well worth the effort, however, and are the subject of the remainder of this article. Higher speed, longer word-length microprocessors and cheaper memory can only extend the quality and flexibility of D/A synthesis to the point that synthesizer boards will go the way of discrete-transistor logic circuits.

Digital Audio Properties

For the benefit of those who may have not have seen it before, I shall now briefly describe the theory of D/A and analog-to-digital (A/D) conversion. More details, including mathematical proofs, may be found in many of the references. Everything discussed applies equally well to conversion in both directions, although the emphasis is on synthesis using D/A conversion.

A *digital-to-analog converter* is best described as a programmable power supply that generates an instantaneous output voltage (or current) directly proportional to a numerical value received from the computer, typically through a parallel output port. When the program changes the value sent to the converter, the output voltage immediately changes to the new value.

To approximate an audio waveform, the D/A-converter input is rapidly updated with numbers representing discrete points along the desired continuous waveform. The update rate or *sample rate* is nearly always constant and is chosen when the system is designed. Obviously any finite sample rate will lead to some degree of distortion, since the D/A converter will be generating a stair-step approximation to normally well-rounded audio waveforms.

Another source of distortion is the error that results when waveform computations are truncated to fit the word length of the D/A converter. The central question then, is what kind of and how much distortion is introduced through this two-dimensional quantization (approximation) of smooth audio waveforms.

Let us look first at sample-rate effects, which represent waveform quantization in *time*. It is easily shown that when the sampling is dense with respect to the frequency content of the waveform being reproduced, the distortion components are

Circle 37 on inquiry card. ➡

Advanced Real-Time Music Synthesis Techniques

Hal Chamberlin
29 Mead St
Manchester NH 03104

At this time, sound and music synthesis is a well established application of small computer systems. Currently there is some kind of music program for every microcomputer system known to the author; even a musical calculator advertisement has been seen (the unit also calculates). All of the recently introduced packaged personal computers have some kind of built-in provision for sound generation, and while aimed primarily at sound effects for games, all have music programs of varying degrees of sophistication. Several independent manufacturers offer more serious music software systems, most of which make use of specialized music hardware as well. All in all, music synthesis on personal computer systems is taking on greater importance every year and soon may approach the popularity of accounting, word processing, and games as a major application area.

Programmed performance of music by a low-cost microcomputer has many "practical" applications beyond the sheer gratification of coding the score, orchestrating the piece, and hearing the results. I have heard from a man who has taken the four-voice synthesis program from my previous article "A Sampling of Techniques for Computer Performance of Music" (September 1977 BYTE, page 62) and used it extensively in producing commercial music for radio and television advertising (about 75% of all such music is synthesized nowadays). Another person has used it with a KIM-1 system to supply simulated organ music for a small rural church. Yet another fills long hours of hospital confinement with music from an inexpensive single-board microcomputer. Some university music departments have even disguised ear-training exercises for students as a stimulating computer game. Surely music synthesis as an everyday application of personal computers need not be justified further.

Perceived difficulties in computing waveforms fast enough for real-time performance have limited the application of D/A conversion in low-cost systems.

At this point, the discussion is going to be confined to the more advanced microcomputer-music-synthesis systems. Such a system must be able to synthesize at least three tones simultaneously (for chords) and have some degree of control over the timbre (tone color) of the notes so that "orchestration" of the piece becomes a variable.

Fundamental Synthesis Techniques

A computer may produce musical sounds either by *controlling* the operation of an external sound synthesizer or by *computing* the sound waveform itself and using a digital-to-analog (D/A) converter to make it audible. Of these two methods it would seem that computing the waveform is more desirable; then the system would not be limited by the quantity and variety of external sound-generating elements. This is indeed the case, but perceived difficulties in computing waveforms fast enough for *real-time* performance have limited the application of the D/A conversion method in low-cost systems.

Because of this, we find an abundance of synthesizer boards on the market and a relative dearth of D/A converters with the necessary audio-postprocessing circuitry and supporting software. One example of a currently available synthesizer board is the SSM SB-1 (for S-100 bus systems), which allows control over the frequency, waveform, and amplitude for a single tone per board. ALF Products offers a small Apple II-compatible synthesizer (as well as a larger S-100 bus unit) which allows control over the frequency and amplitude of three rectangular waveforms per board. RCA has an inexpensive, two-voice, square-wave synthesizer for its COSMAC VIP system which can be used in multiples for more complex music. While the previous devices are add-on accessories, the Texas Instruments 99/4 personal computer has a built-in,

Circle 103 on inquiry card. ⟶

MICROSOFT AND TRS-80™ MODEL II. RUNNING THE SHOW.

TRS-80 Model II is designed for professional business applications. Your ultimate goal for your Model II is probably a fast, turnkey system that's easy to use and easy to expand. To get there you need dependable, flexible system software to write the programs that run the whole show.

Microsoft's COBOL-80 and BASIC compilers are now available in versions fully compatible with Model II TRSDOS. You can have either of these universally popular programming languages plus all the advantages of a compiler: faster execution times, compact executable code, security for your programs.

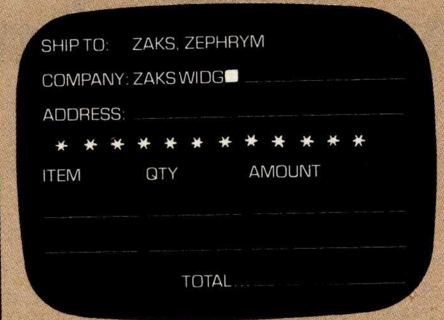
With Microsoft's compiled languages you get a complete program development system, including our standard MACRO-80 Assembler and LINK-80 Linking Loader. Your compiled programs are relocatable modules that can be linked to each other or to Z80 assembly language subroutines.

COBOL-80 Compiler

Microsoft's COBOL-80 is an ANSI-74 standard COBOL that supports such advanced data manipulation verbs as COMPUTE, INSPECT, STRING, UNSTRING, and SEARCH. Plus three-dimension arrays, full COPY facility, compound and abbreviated conditions, and an optional packed decimal format that saves on mass storage by as much as 40%. In addition to Sequential and Relative files, COBOL provides Indexed files, allowing records to be retrieved with a user-specified key instead of a record number.

Interactive Screen Handling Most business applications require machine interaction, formatted screen displays, and the ability to insert and delete information as the machine prompts the user. The COBOL ACCEPT/DISPLAY verbs are implemented for this purpose—to DISPLAY formatted screens and ACCEPT operator input.

CHAIN and Segmentation Ideal for menu-driven application programs is COBOL-80's CHAIN feature. With CHAIN, control is transferred from the menu program to any executable module as specified at runtime. COBOL-80 also supports Segmentation to make maximum use of memory when large programs are executing.



COBOL-80 formatted screen display

BASIC Compiler

The Microsoft BASIC Compiler has the fastest execution times of any BASIC available. It is language compatible with the Model II's interpreter so you can write and test your programs using the interpreter, then compile them for secure storage and efficient execution.

New BASIC Features In addition to those language features provided with the interpreter, the BASIC compiler supports all the latest features of Microsoft BASIC 5.1: WHILE conditional statement, CALL, long variable names, and ANSI compatibility. Plus the compiler has double precision transcendental functions (SIN, COS, TAN, ATN, LOG, EXP, SQR).

Secure Besides being an indispensable system software tool for developing your own utilities and application programs, the BASIC compiler is ideal for producing programs for resale. The machine code for any application program may be placed on a diskette, ROM, or other media, but the BASIC source program need not be distributed. Thus the original application program is protected from unauthorized alteration.

```
110  I = 4*J: K = (4*J-1) AND &HOFFO
**0025' L00110:    LD     HL,(J%)
**0028'            ADD    HL,HL
**0029'            ADD    HL,HL
**002A'            LD     (I%),HL
**002D'            DEC    HL
**002E'            LD     A,L
**002F'            AND    FO
**0031'            LD     L,A
**0032'            LD     A,H
**0033'            AND    OF
**0035'            LD     H,A
**0036'            LD     (K%),HL
```

BASIC compiler object code listing

Optimized Machine Code Compiled BASIC programs are fast and compact due to extensive optimizations performed during compilation:
1. Expressions are reordered to minimize temporary storage and eliminate common subexpressions **2.** Constants are folded wherever possible **3.** Peephole optimizations are performed **4.** The code generator is template-driven, allowing optimal sequences to be generated for the most commonly used operations **5.** String operations and garbage collection are extremely fast

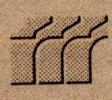
Get Microsoft BASIC Compiler or Microsoft COBOL-80 and get serious with your Model II. After all, who's running this show?

Prices for COBOL-80 and BASIC Compiler include the MACRO-80 Assembler and LINK-80 Linking Loader and all documentation. Documentation purchased separately, $20.

COBOL-80	$750.
BASIC Compiler	$395.

For TRS-80 Model I software, contact Microsoft Consumer Products.

MICROSOFT



10800 NE 8th
Suite 819
Bellevue, WA 98004
(206) 455-8080
Telex 328945

We set the standard.

A White-Noise Generator for the Apple II

John O'Flaherty, 3432 A Evergreen Ln, St Louis MO 63125

Listing 1 is a simple machine-language routine to turn an Apple II into a white-noise generator. The program is a software machine that simulates the National Semiconductor MM5837 Digital Noise Generator (see figure 1).

It uses 2 bytes of memory, hexadecimal locations 300 and 301 (see listing 1) as sixteen of the shift-register stages, and the processor-status-register carry flag as the seventeenth.

The rotate-left (ROL) instruction at hexadecimal location 303 shifts the bits of the low-order memory location (hexadecimal 300) left, moving bit 8 into the carry flag. The next ROL instruction, at location 306, shifts each bit of location 301 left, shifts the carry flag into bit 0 of location 301, and shifts bit 8 into the carry flag. One seventeen-bit shift cycle is now complete.

At this point, if the carry flag, which is now the output bit of the seventeen-stage register, is equal to 0, the program jumps to location 30E; but if it is set to 1, the program toggles the speaker by the instruction at hexadecimal location 30B.

Now the accumulator is rotated right three times, bringing the carry flag (bit 17) into bit 6 of the accumulator, which is exclusive-ORed (at location 311) with bit 6 of location 301 (bit 14). Then the accumulator is shifted left three times to put the bit of interest back into the carry flag. Then control branches back to address 303 with the correct bit ready to be shifted into the front of the low-order memory byte by the ROL instruction.

The routine is entered at hexadecimal address 302. Reset must be pressed to stop the program.

It is also possible to insert counting loops and a conditional subroutine return to create a time-limited burst of white noise: the program in listing 2 will produce a short "chiff" sound.

With seventeen stages of shift register in a pseudorandom circuit, there are nearly 2^{17} or 131,071 unique states. The cycle time of the loop averages 27 microseconds, so the total cycle time before repetition will be 3.54 seconds (for the program of listing 1).■

Listing 1: *6502 assembly language program for a continuous white-noise generator.*

```
300  XX              (low-order)
301  XX              (high-order)
302  38              SEC
303  2E  00  03      ROL  $300
306  2E  01  03      ROL  $301
309  90  03          BCC  $30E
30B  AD  30  C0      LDA  $C030
30E  6A              ROR  ACC
30F  6A              ROR  ACC
310  6A              ROR  ACC
311  4D  01  03      EOR  $301
314  0A              ASL  ACC
315  0A              ASL  ACC
316  0A              ASL  ACC
317  4C  03  03      JMP  $303
```

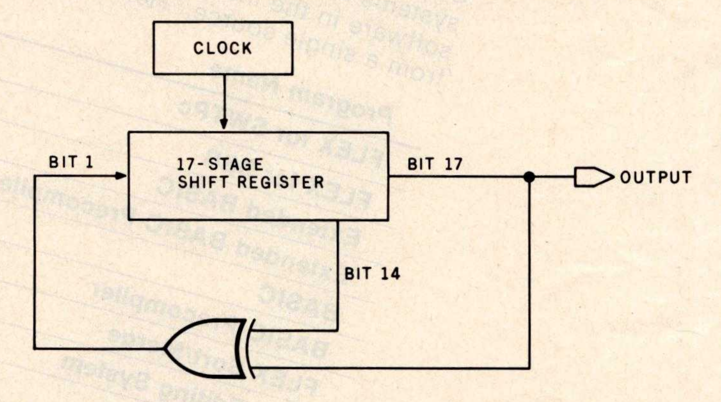


Figure 1: *Logic diagram of the National Semiconductor MM5837 digital noise generator circuit.*

Listing 2: *Subroutine to generate bursts of white noise.*

```
300  XX              (low-order)
301  XX              (high-order)
302  A9  00          LDA  #$00
304  A8              TAY
305  38              SEC
306  2E  00  03      ROL  $300
309  2E  01  03      ROL  $301
30C  90  03          BCC  $311
30E  AD  30  C0      LDA  $C030
311  6A              ROR  ACC
312  6A              ROR  ACC
313  6A              ROR  ACC
314  4D  01  03      EOR  $301
317  0A              ASL  ACC
318  0A              ASL  ACC
319  0A              ASL  ACC
31A  88              DEY
31B  98              TYA
31C  D0  01          BNE  $31F
31E  60              RTS
31F  4C  06  03      JMP  $306
```


Circle 34 on inquiry card. →

BYTE's Bugs

Current Sinking

I found the article by Mark Bernstein, entitled "Morse Code Trainer" (December 1979 BYTE, page 247) very interesting. I did, however, find one disturbing item in the circuitry. Figure 3, on page 248, shows a 7404 inverter driving a transistor-radio speaker through a 100-ohm resistor to ground. This arrangement requires that the inverter source current on the order of 40 mA. According to the National Semiconductor Corp *TTL Databook*, a 7404 inverter can source roughly 0.5 mA. Thus, the ground symbol in the circuit diagram *should* clearly read "+5 V" (I assume that this was a layout error). However, the *TTL Databook* also specifies maximum sink current on the order of 20 mA per inverter. Therefore, the 40 mA sink requirement for the circuit is marginal. The circuit probably works with no apparent adverse effects, but the inverter is being overstressed nonetheless. The oscillator duty cycle may be the saving grace. For a more reliable design, I suggest that the resistor value be increased to 300 ohms.

J C Hassall
H and H Enterprises
Microcomputer Specialists
1201 Highland Cr
Blacksburg VA 24060

We brought this question to the attention of our hardware expert, Steve Ciarcia. He gave us the following reply: "The circuit shown in the article does work in its present configuration. The 0.5 mA specification is the maximum current that can be sourced by the 7404 while maintaining a logical 1 output (the minimum voltage for a logical 1 is 3.5 V). Actually, the 7404 can put out a lot more current than that, but the voltage will drop below 3.5 V. This is no problem when you are using the device as a linear amplifier to drive a loudspeaker (a somewhat unconventional application for the 7404). To prevent undue stress on the 7404, it is probably best to tie the speaker to +5 V rather than to ground, and to use a 470 ohm resistor instead of 100 ohm."

Ultrasonic Substitution

The schematic diagram of figure 4 in the January Ciarcia's Circuit Cellar ("Computerize a Home," by Steve Ciarcia, January 1980 BYTE, page 28) specifies that a Model TR-89 40 kHz ultrasonic transducer from Massa Products Corporation be used. Several readers have made inquiries concerning how to get this component.

Steve Ciarcia suggests that an equivalent transducer from Panasonic be substituted for the Massa Products unit. The Panasonic transducer may be ordered from: The MicroMint Inc, 917 Midway, Woodmere NY 11598, telephone (516) 374-6793.

The MicroMint stock number for the device is MM1002; the cost is $6 postpaid.

A Dotty Ratio

An alert reader in Morro Bay, California, discovered an error in the article "Morse Code Trainer" by Mark Bernstein, which appeared in the December 1979 BYTE (page 247). In listing 1, on page 248, the values given for constants that determine the relative lengths of dots and dashes cause the ratio of lengths to be incorrect. The values given in the article (dot = 1000, dash = 2000) give a 1 to 2 ratio. The correct ratio is 1 to 3. One set of values that could be used for the correct ratio is dot = 1000 and dash = 3000. ■


```
5010    PLOT3:PLOT35:PLOT10
5020    PRINT" $$$$$$$ "
5030    FOR I=12 TO 36 STEP 2
5040    PLOT03:PLOT27:PLOT I
5050    PLOT6:PLOT34
5060    FOR K=1 TO 25:PLOT32:NEXT K
5070    NEXT I
5073    REM HANDLE
5075    PLOT6:PLOT120
5080    FOR I=16 TO 26 STEP 2
5090    PLOT3:PLOT54:PLOT I
6000    PLOT32
6010    NEXT I
6015    REM CONNECT HANDLE TO BODY
6020    PLOT15:PLOT3:PLOT52:PLOT27
6030    PLOT32:PLOT32
6035    REM ORNAMENTS
6038    PLOT6:PLOT16
6040    PLOT3:PLOT33:PLOT11
6050    PLOT32:PLOT32
6060    PLOT3:PLOT44:PLOT11
6070    PLOT32:PLOT32
6075    REM PAYOFF SLOT
6080    PLOT6:PLOT7
6090    FOR I=30 TO 32
7000    PLOT3:PLOT34:PLOT I
7010    FOR J=1 TO 11
7020    PLOT32:NEXT J
7030    NEXT I
7032    REM IN SLOT
7034    PLOT3:PLOT49:PLOT14:PLOT32
7035    PLOT10:PLOT26:PLOT32
7036    PLOT10:PLOT26:PLOT32
7038    REM PRINT
7040    PLOT3:PLOT34:PLOT26:PLOT6
7050    PLOT3:PRINT"INTECOLOR"
7060    PLOT3:PLOT36:PLOT28:PLOT6
7070    PLOT3:PRINT"CASINO"
7072    PLOT3:PLOT34:PLOT14
7073    PLOT6:PLOT37
7074    PLOT14:PRINT "BIG BERTHA"
7080    REM WINDOWS
7090    PLOT15:PLOT3:PLOT28:PLOT18
8000    PLOT6:PLOT56
8005    PRINT"                  "
8007    PLOT3:PLOT28:PLOT19
8010    PRINT "LIBERTY LIBERTY LIBERTY"
8015    PLOT14
8020    PLOT6:PLOT16
8030    PLOT3:PLOT35:PLOT18:PLOT32
8040    PLOT3:PLOT43:PLOT18:PLOT32
8050    PLOT3:PLOT29:PLOT42
8060    PLOT14:PLOT6:PLOT7
8070    PRINT"YOUR BALANCE IS $";S
8075    PLOT3:PLOT80:PLOT0
8080    RETURN
9000    REM PULL THE HANDLE
9005    PLOT14:PLOT6:PLOT7
9010    FOR I=16 TO 24 STEP 2
9020    PLOT3:PLOT54:PLOT I
9030    FOR J=1 TO 20:NEXT J
9040    PLOT32:NEXT I
9042    REM CLEAR THE COIN SLOT
9043    PLOT15
9044    PLOT3:PLOT49:PLOT14:PLOT32
9046    PLOT10:PLOT26:PLOT32
9048    PLOT10:PLOT26:PLOT32
9050    PLOT14
9055    PLOT6:PLOT120
9060    FOR I=24 TO 16 STEP-2
9070    PLOT3:PLOT54:PLOT I
9080    FOR J=1 TO 20:NEXT J
9090    PLOT32
9095    NEXT I
9098    PLOT6:PLOT57
9099    PLOT15
10000   FOR I=1 TO 5
10010   FOR J=1 TO 6
10020   PLOT3:PLOT28:PLOT19
10022   IF I>3 THEN 10045
10024   PLOT14:PRINT"        "
10026   PLOT3:PLOT28:PLOT19:PLOT15
10028   IF I>3 THEN 10045
10030   IF I<3 THEN PRINT T$(J)
10035   IF I=3 THEN PRINT T$(T(1))
10045   PLOT3:PLOT36:PLOT19
10046   IF I>4 THEN 10066
10047   PLOT14:PRINT"        "
10048   PLOT3:PLOT36:PLOT19:PLOT15
10049   IF I>4 THEN 10066
10050   IF I<4 THEN PRINT T$(J)
10055   IF I=4 THEN PRINT T$(T(2))
10066   PLOT3:PLOT44:PLOT19
10067   PLOT14:PRINT"        "
10068   PLOT3:PLOT44:PLOT19:PLOT15
10070   IF I<5 THEN PRINT T$(J)
10075   IF I=5 THEN PRINT T$(T(3))
10080   NEXT J
10090   NEXT I
10100   PLOT15:PLOT6:PLOT7
10110   RETURN
10120   REM OUT OF MONEY
10125   PLOT12:PLOT14:PLOT6:PLOT1
10130   PRINT:PRINT:PRINT:PRINT "YOU HAVE RUN OUT OF MONEY MY FRIEND"
10140   PRINT:PRINT "THE GAME IS OVER. . .BETTER LUCK NEXT TIME"
10150   PRINT:PRINT "DID YOU HAVE A GOOD TIME";:INPUT A$
10160   RETURN ■
```

Listing 1 continued:

```
4480  PLOT3:PLOT37:PLOT32
4490  PRINT"           "
4495  RETURN
4500  REM BAD BET PLACED
4510  PLOT3:PLOT56:PLOT15
4520  PLOT6:PLOT65:PLOT14
4530  PRINT "BAD BET      "
4535  PLOT3:PLOT80:PLOT0
4540  FOR I=1 TO 500:NEXT I
4550  PLOT15:PLOT6:PLOT7
4560  REM CLEAR SLOT
4570  PLOT3:PLOT49;PLOT14:PLOT32
4580  PLOT10:PLOT26:PLOT32
4590  PLOT10:PLOT26:PLOT32
4600  RETURN
4700  REM JACKPOT
4720  PLOT14:PLOT3:PLOT36:PLOT10
4730  PLOT6:PLOT79
4740  PRINT "JACKPOT"
4742  PLOT3:PLOT34:PLOT14
4744  PRINT "BIG BERTHA"
4750  PLOT3:PLOT80:PLOT0
4765  FOR I=1 TO 25:OUT7,64
4766  FOR J=1 TO 20:OUT7,0:NEXTJ:NEXTI
4768  PLOT3:PLOT36:PLOT10
4770  PLOT6:PLOT34:PRINT"$$$$$$$"
4772  PLOT3:PLOT34:PLOT14:PLOT6:PLOT37
4774  PRINT "BIG BERTHA"
4780  PLOT15:PLOT6:PLOT7
4790  RETURN
4800  REM WANTS TO QUIT
4810  PLOT12:PLOT6:PLOT7:PLOT14
4820  PRINT:PRINT:PRINT:PRINT "SO. . .YOU WANT TO QUIT. . . . ."
4830  PRINT:PRINT:PRINT "STOP OVER AT THE ROULETTE TABLE AND TRY YOUR LUCK"
4840  PRINT:PRINT "SEE YOU AROUND THE SLOTS AGAIN SOMETIME"
4850  FOR I=1 TO 2500:NEXT I
4860  PLOT15:PLOT6:PLOT7
4870  END
4900  REM BREAKS THE BANK
4910  PLOT12:PLOT6:PLOT8:PLOT12
4920  FOR I=1 TO 100:NEXT I
4930  PLOT6:PLOT7:PLOT12:PLOT14:PLOT6:PLOT15
4940  PRINT:PRINT:PRINT:PRINT:PRINT "YOU 'B R O K E  T H E  B A N K'
4950  PRINT:PRINT "YOUR WINNINGS AMOUNT TO $";S
4960  PRINT:PRINT "THE GAME IS OVER — YOU HAVE WON TOO MUCH AND"
4970  PRINT:PRINT "YOU ARE UNDER INVESTIGATION BY THE 'IGB'"
4980  PRINT:PRINT "(INTECOLOR GAMBLING BUREAU)"
4985  FOR I=1 TO 4000:NEXT I
4990  PLOT15:PLOT6:PLOT7
4995  RETURN
4999  REM DRAW MACHINE
5000  PLOT12:PLOT14
5005  PLOT6:PLOT34
```

```
580    GOTO 510
590    REM
600    FOR I=1 TO 3                    :REM FIND THE 3 RESULTS
610    R=RND(R1)
620    FOR J=1 TO 6                    :REM AND LOOK ACROSS THE PROB. MATRIX
630    T(I)=J                          :REM REMEMBERING THE CURRENT COLUMN
640    IF R<P(I,J) THEN 660            :REM IS IT THIS ONE?
650    NEXT J                          :REM NO..KEEP LOOKING
660    NEXT I                          :REM T(I) IS THE ITH RESULT
670    GOSUB 9000                      :REM DISPLAY THE RESULTS
680    D=100*T(1)+10*T(2)+T(3)         :REM CODE RESULT AS INTEGER
690    FOR I=1 TO 15
700    IF D=D(1,I) THEN 750            :REM IF INTEGER THEN WIN
710    NEXT I                          :REM ELSE KEEP LOOKING
720    REM
730    D=0                             :REM SET WINNINGS TO ZERO
740    GOTO 820
750    IF D(2,I)<0 THEN 780            :REM IS IT A JACKPOT
760    D=Z*D(2,I)                      :REM NO--CALCULATE PAYOFF
770    GOTO 810          :REM AND DISPLAY
780    D=INT(200+400*RND(R1))          :REM 'JACKPOT'
790    GOSUB 4700                      :REM DISPLAY JACKPOT
800    REM
810    GOSUB 4200                      :REM DROP WINNINGS
820    S=S+D-Z                         :REM CALCULATE NEW BALANCE
830    IF S<=0 THEN 870                :REM IS USER BROKE?
840    IF S>=1000 THEN 910
850    GOSUB 4400                      :REM UPDATE BALANCE
860    GOTO 510                        :REM GET NEW BET
870    REM HERE IF USER BROKE
880    GOSUB 10120                       :REM DISPLAY BROKE
890    GOTO 950                        :REM ASK ABOUT ANOTHER GAME
910    GOSUB 4900                        :REM BROKE THE BANK
950    REM ANOTHER GAME?
960    PLOT12
970    PRINT:PRINT "HOW ABOUT ANOTHER GO? (Y OR N) ";:INPUT A$
980    IF A$="Y" THEN 480
985    PLOT14:PLOT6:PLOT2
990    PRINT:PRINT "WELL I HOPE YOU HAD A BIT OF THRILL AND WE HOPE"
1000   PRINT "TO SEE YOU BACK AT THE 'COMPUCOLOR CASINO' REAL SOON"
1010   PRINT:PRINT "SEE WHEN YOU HAVE MORE MONEY TO DONATE"
1020   FOR I=1 TO 2500:NEXT I
1030   PLOT15:PLOT6:PLOT7:PLOT12
1040   END
4000   REM PLACE THE BET
4010   PLOT3:PLOT56:PLOT15
4020   PLOT6:PLOT79:PLOT14
4030   PRINT "PLACE BET"
4035   PLOT3:PLOT80:PLOT0
4040   FOR I=1 TO 500
4050   NEXT I
4060   PLOT3:PLOT56:PLOT15
4070   PLOT6:PLOT2
4080   PRINT "          "
4090   REM PUT INPUT IN SLOT
4100   PLOT15:PLOT6:PLOT2
4105   PLOT3:PLOT49:PLOT14
4110   PLOT155:PLOT10
4120   INPUT "";Z
4130   PLOT155:PLOT11
4140   PLOT155:PLOT24
4150   PLOT6:PLOT7
4160   RETURN
4200   REM DROP WINNINGS
4210   PLOT15:PLOT3:PLOT37:PLOT30
4220   PLOT6:PLOT7
4225   REM
4230   PRINT "WINNER"
4232   FOR I=1 TO 25:OUT7,64
4234   FOR J=1 TO 15:OUT7,0:NEXT J:NEXT I
4240   PLOT3:PT37:PLOT32
4250   PLOT6:PLOT2
4260   PRINT "$ ";D
4270   PLOT3:PLOT80:PLOT0
4280   PLOT6:PLOT7
4290   FOR I=1 TO 1000:NEXT I
4300   RETURN
4400   REM SHOW ACCUM AND CLEAR DROP
4410   PLOT14:PLOT3:PLOT46:PLOT42
4420   PLOT6:PLOT2
4430   PRINT S
4440   PLOT15:PLOT6:PLOT7
4450   REM CLEAN OUT DROP
4460   PLOT3:PLOT37:PLOT30
4470   PRINT"          "
```

Listing 1 continued on page 64

Listing 1: *BASIC listing of the slot machine program.*

```
100     REM THE GAME OF SLOT MACHINE RUNS IN 8K AND WAS
110     REM CONVERTED FROM DARTMOUTH BASIC FOR THE ISC8001 BY:
120     REM W.C. HOFFER-2721 N. WANDA-SIMI VALLEY, CA-93065
122     PLOT6:PLOT33:PLOT12:PLOT27:PLOT11:PLOT14:PLOT3:PLOT17:PLOT6
124     PLOT6:PLOT25
126     PRINT "INTECOLOR PRESENTS THE ONE ARMED BANDIT"
135     PLOT3:PLOT80:PLOT0
140     FOR I=1 TO 1000:NEXT I
150     PLOT6:PLOT2:PLOT12
200     DIM P(3,6),T$(6),D(2,15)
205     DIM T(3)
210     R1=4
220     PRINT
240     FOR I=1 TO 3
242     FOR J=1 TO 6
244     READ P(I,J)
246     NEXT J
248     NEXT I
249     REM PROBABILITY MATRIX (MODIFIED FOR BETTER PAYOFFS & JACKPOTS)
250     DATA 0,.4,.65,.83,.9,1
260     DATA .1,.45,.65,.80,.87,1
270     DATA .3,.45,.5,.7,.9,1
280     FOR I=1 TO 6
282     READ T$(I)
284     NEXT I
285     DATA "↑]↑S↑[B↑Y↑Y↑P↑T↑U↑ \ ↑S↑W↑V↑Y↑S↑R↑Q↑W↑V↑U↑T
        ↑Q↑R↑T↑U↑V↑W↑Y↑S↑R↑Q↑P↑V↑U↑T↑ \ ↑S↑R↑Q↑P↑W↑V↑U↑Y↑S↑R↑W
        ↑Q↑T↑Y↑Y↑CC↑]↑W"
286     REM
287     DATA "↑]↑Q↑[B↑Y↑Y↑T↑U↑ \ ↑W↑V↑Y↑S↑R↑Q↑W↑V↑U↑T
        ↑Q↑R↑T↑U↑V↑W↑Y↑S↑R↑Q↑P↑V↑U↑T↑ \ ↑S↑R↑Q↑P↑W↑V↑U↑Y↑S↑R
        ↑Q↑Y↑Y↑CC↑]↑W"
288     REM
290     DATA "↑]↑R↑[B↑Y↑Y↑T↑U↑ \ ↑W↑V↑Y↑S↑R↑Q↑W↑V↑U↑T
        ↑Q↑R↑T↑U↑V↑W↑Y↑R↑Q↑P↑U↑T↑ \ ↑S↑R↑Q↑W↑V
        ↑Y↑Y↑CC↑]↑W"
293     REM
294     DATA "↑]↑U↑[B ↑U↑T↑ \ ↑W↑V↑Y↑S↑R↑Q↑W↑V↑U↑T
        ↑Q↑R↑T↑U↑V↑W↑Y↑S↑R↑Q↑P↑V↑U↑T↑ \ ↑S↑R↑Q↑P↑W↑V↑U↑Y↑S↑R
        ↑Q↑Y↑Y↑CC↑]↑W"
295     REM
296     DATA "↑]↑V↑[B↑Y↑S↑W↑V↑ \ ↑Q↑U↑P↑T↑Y↑P↑T↑Q↑U↑V↑W
        ↑Q↑R↑S↑W↑V↑U↑T↑Y↑S↑R↑Q↑P↑T↑U↑V↑W↑ \ ↑S↑R↑Q↑P↑W↑V↑U↑T↑V↑W↑Y↑P↑Q↑T↑U
        ↑W↑R↑Y↑Y↑CC↑]↑W"
297     REM LIBERTY IN BLACK
298     DATA "↑]↑PLIBERTY↑]↑W"
300     FOR I=1 TO 2
302     FOR J=1 TO 15
306     READ D(I,J)
308     NEXT J:NEXT I
310     DATA 221,222,223,224,225,226,333,335,336,444,445,446,555,556,666
320     DATA 2,-1,2,2,4,6,-1,16,18,-1,20,22,-1,24,-1
330     INPUT "WOULD YOU LIKE INSTRUCTIONS? (Y OR N) ";A$
340     PRINT
350     IF A$="N" THEN 470
360     PLOT14:PLOT6:PLOT2
370     PRINT "RULES OF PLAY:"
380     PRINT "ON EACH PLAY YOU CAN BET ANY NUMBER OF 'SILVER DOLLARS'"
390     PRINT "BETWEEN $1 AND YOUR BALANCE OR $999 WHICHEVER IS SMALLER."
400     PRINT "JUST TYPE IN THE NUMBER WHEN THE 'PLACE BET' SIGN STOPS BLINKING."
405     PRINT "(FULL DOLLAR BETS ONLY PLEASE)"
410     PRINT
420     PRINT "YOU 'PULL DOWN THE HANDLE' BY DEPRESSING THE RETURN KEY."
430     PRINT
440     PRINT "THE GAME IS OVER WHEN YOUR BALANCE REACHES ZERO OR"
450     PRINT "YOU BREAK THE BANK. IF YOU DECIDE TO QUIT EARLY THEN, BET 0."
452     PRINT "HERE IS WHAT THE SYMBOLS LOOK LIKE:"
453     PRINT: PLOT15
454     PRINT "↑]↑SLEMON↑]↑W ";T$(1);" ↑]↑QCHERRY ↑]↑W";T$(2)
455     PRINT
456     PRINT " ↑]↑RORANGE(UNRIPE) ↑]↑W";T$(3);"↑]↑UPLUM ↑]↑W";T$(4)
457     PRINT
458     PRINT " ↑]↑VBELL ↑]↑W";T$(5);" LIBERTY ";"↑]↑P↑↑↑WLIBERTY↑]↑W↑↑↑P"
459     PRINT:PRINT:PRINT:PLOT14
470     PRINT "HIT THE SPACE BAR WHEN YOU ARE READY TO BEGIN"
475     R1=RND(1):IF INP(1)<>96 THEN 475
480     S=200            :REM GIVE A STARTING BALANCE
490     GOSUB 5000
510     GOSUB 4000                      :REM ASK FOR THE BET
520     Z=INT(Z)         :REM FULL DOLLARS ONLY
530     IF Z=0 THEN GOSUB 4800          :REM WANTS TO QUIT NOW
540     IF Z<0 THEN 560
550     IF Z<S+1 THEN 590               :REM TRYING TO BET MORE THAN BALANCE
560     GOSUB 4500                      :REM ERROR ROUTINE
```

An Animated Slot Machine in Color

W C Hoffer, Hughes Aircraft Co
8433 Fallbrook, Bldg 265, Mail Sta P-35
Canoga Park CA 91304

Nearly everyone has some gambling desire in his chemistry. Many dollars have been spent in the pursuit of gambling happiness. If you are the owner of, or have access to an Intecolor or Compucolor microcomputer system, this program (see listing 1, pages 62 thru 65) may satisfy some of your gambling anxieties.

The program was originally written in Dartmouth BASIC. I converted it and then added the color and animation. Since the hard copy listing cannot display the graphics or colors, which consist of a series of control codes, you will see the symbol ↑ (up arrow) throughout the listing. This symbol stands for the control key on the keyboard. In each case, the ↑ is followed by an American Standard Code for Information Interchange (ASCII) character. An example is ↑]↑S, which means "control-], control-S," and converts to "set foreground color to yellow," in Compucolor nomenclature. Occasionally you will see ↑↑ which again means "control ↑" or "set background color." Keep in mind that the ↑ is also an ASCII character. The program has been generously laced with comment statements in an effort to inform you of the function performed by each section of code.

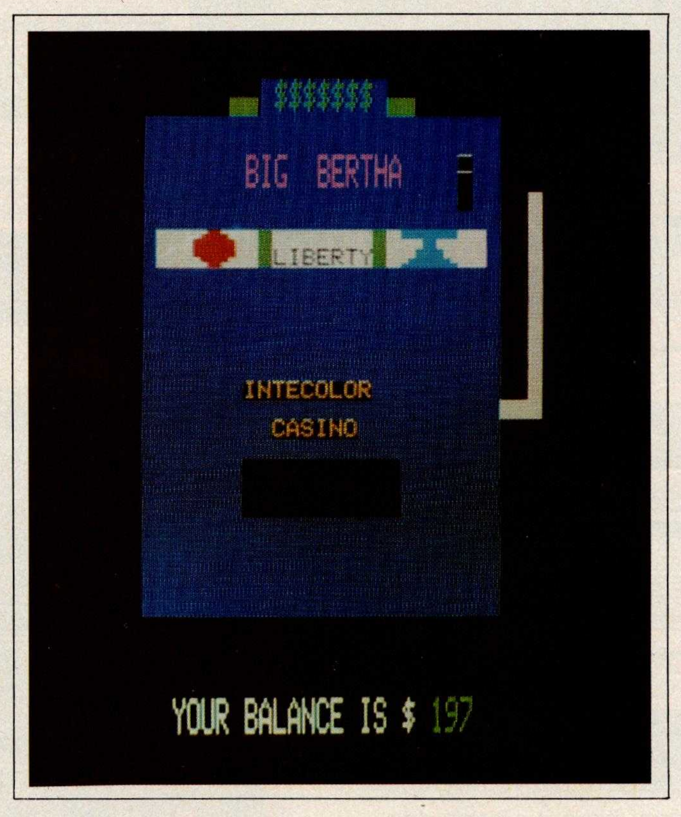


Photo 1: *A graphic representation of an animated slot machine on the Intecolor microcomputer system.*

Since the machine cannot display an orange color, the orange fruit in the slot machine is displayed as unripe green. My original version of this program, which has made its way into the user world, displayed only the words (PLUM, BELL, etc) in the windows. This version displays the graphic representation of each symbol. The gambler should request instructions when first using the program, and have the rules of play and the symbols displayed and explained.

I am sure you will do quite well with this gambling endeavor since I have modified the original Las Vegas odds in favor of the player.

About the Author

Mr Hoffer began his data processing career in 1966, and has lectured on FORTRAN at the University of Arizona. Since 1976 he has been involved in an on-going evaluation of small systems. Mr Hoffer is presently employed at Hughes Aircraft Company as Manager of Computing and Data Processing for the Missile Systems Group, in Canoga Park, California.

Listing 1 continued:

```
FF6C   52                       PUSH   DX
FF6D   56                       PUSH   SI
FF6E   57                       PUSH   DI
FF6F   55                       PUSH   BP
FF70   06                       PUSH   ES
FF71   8926A700     R           MOV    STACKP,SP        ;AND SET STACK & DATA
FF75   8CD1                     MOV    CX,SS
FF77   33C0                     XOR    AX,AX            ;SEGMENTS FOR USER 1.
FF79   8ED0                     MOV    SS,AX
FF7B   8ED8                     MOV    DS,AX
FF7D   8B26A700     R           MOV    SP,STACKP
FF81   36890E0C00               MOV    SS:STACKS,CX
FF86   53                       PUSH   BX
FF87   C3                       RET
----                    CODE ENDS
----                    CONST2 SEGMENT
FFF0                    ORG 0FFF0H
FFF0   B8----       R           MOV    AX,DGROUP
FFF3   8ED8                     MOV    DS,AX
FFF5   BC7F0090     R           MOV    SP,OFFSET(STK)
FFF9   EA               DB      0EAH                    BOOTSTRAP
FFFA   94FD         R   DW OFFSET INIT
FFFC   0000             DW 0
----                    CONST2 ENDS



----                    CONST   SEGMENT

0055   483F             HOW     DB      'H?',CR
0057   0D
0058   4F4B             OK      DB      'OK',CR
005A   0D
005B   573F             WHAT    DB      'W?',CR
005D   0D
005E   53               SORRY   DB      'S',CR
005F   0D
```

Text continued from page 52:
interrupt switches the user-tasks on each interrupt cycle and determines when it is time to input and output information to the terminals.

The timer-out routine is shown in flowchart form in figure 4. This interrupt-handling routine is the key to getting the other software to process multiple users.

When called in response to an interrupt, it proceeds thusly. After saving the registers of the current user so that the information stored in them will be available when execution resumes on this user's task, the routine reads a byte from each of the input ports. This is done first so that the inputs will always occur at the same time.

Next, the data is output to the terminals. To accomplish this task, a task-status byte is reserved in memory for each user. This byte is a 1 if the terminal is in an output mode, a 2 if the user terminal is in an input mode, and a 0 if the user's task is currently executing without performing I/O operations.

When the I/O has been taken care of, the processor determines which user-task is to be serviced next. The timer-out routine switches current user-tasks, proceeding to work on the task not most recently processed unless that user is still in an input or output mode. If that user is in an I/O mode, control will go back to the task that was being executed when the timer-out interrupt occurred.

This switching process allows both users to "simultaneously" be served by the same processor. At least to human perception, the service appears to be simultaneous. The flowchart in figure 4 supplies a more detailed accounting of how the multitasking takes place. The assembly code that actually performs the multitasking may be seen in listing 1.

In Conclusion

The hardware discussed in this article is really a bare-bones system. Through the use of more memory (both programmable and read-only memory), as well as through the use of peripheral controllers and programmable interrupt controllers, the whole system could be made to run very efficiently in a multi-user or multiprocessor environment. The possibilities of the new technological developments are impressive.

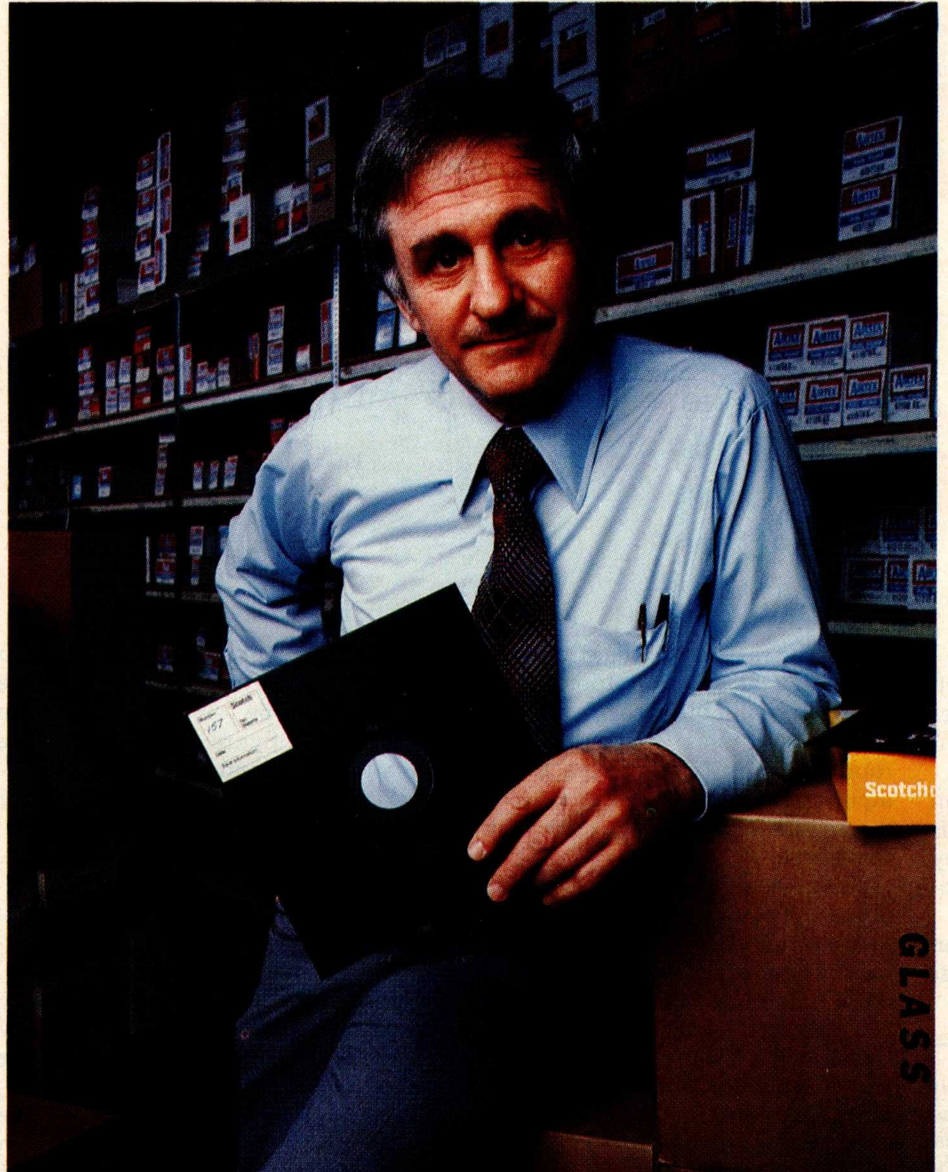
In the future I will try to let you know about some of the other 16-bit microprocessors. I'd like to wait until I get some evaluation hardware, so that I can relay firsthand experience.

Next Month: *Parallel and serial I/O for the TRS-80.* ■

Listing 2: *A benchmark program in Tiny BASIC that can be used to compare execution speeds of various computer systems. It is used here to test the efficiency of the multitasking system.*

```
100 REM 8088 TINY BASIC BENCHMARK
110 REM SINGLE USER-300 BPS
120 LET A=0
130 PRINT"START"
140 FOR B=0 TO 25
150 FOR X=0 TO 1000
160 LET A=A + 1
170 NEXT X
180 LET A=0
190 NEXT B
200 PRINT"DONE"
210 END
```

"Our inventory is our existence. Think we'd trust it to anything less than Scotch® Brand Diskettes?"



Don Stone, President, Mass. Auto Supply Company, Inc., Boston, Mass.

Scotch Diskettes are the diskettes you can depend upon with the information *your* business depends upon.

Each one is tested and certified error-free before it leaves our factory. Because we know nothing less than perfection is acceptable for *your* vital business data.

Scotch Diskettes are available in regular or mini sizes, compatible with almost any system.

To find out where you can purchase Scotch Diskettes, call toll free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division. In Canada, write 3M Canada Inc., London, Ontario, N6A 4T1.

If it's worth remembering, it's worth Scotch Data Recording Products.



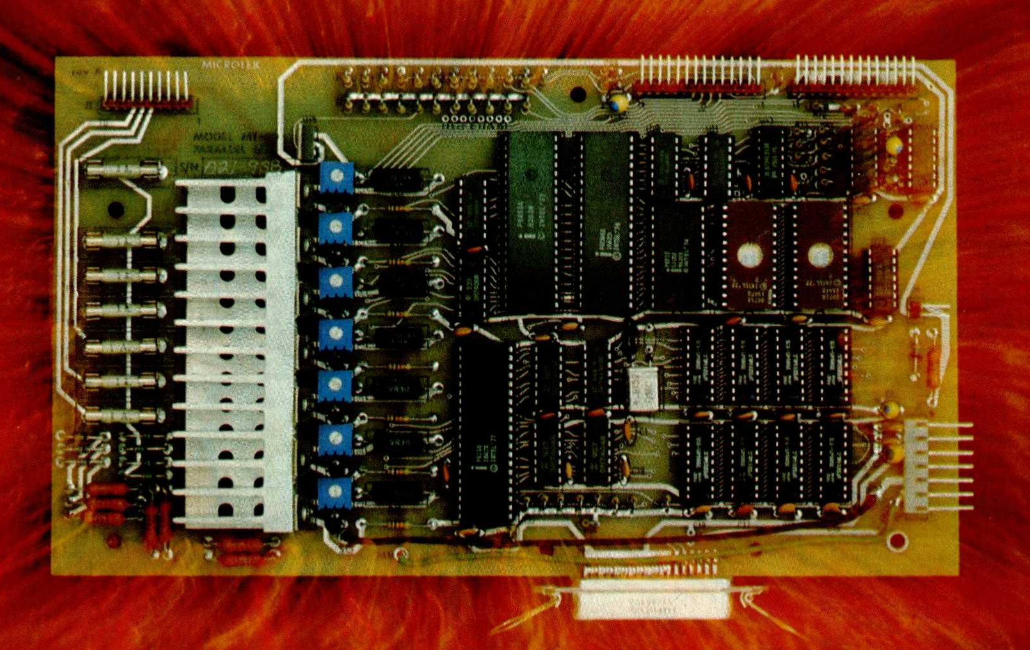
3M

Circle 25 on inquiry card.

Listing 1 continued:

```
FEB2   CF                       IRET                      ;RETURN TO PLACE WHERE
                                                          INTERRUPTED
FEB3   A1AB00         R  OUTWORD: MOV  AX,WORDDOT         ;LOAD WORD OUT
FEB6   8A1EAE00       R         MOV    BL,STATUS          ;LOAD STATUS BYTE
FEBA   80CBFE                   OR     BL,0FEH
FEBD   F6D3                     NOT    BL                 ;MAKE BL = 00 IF IN, CO OR 01 IF
                                                          NOT
FEBF   0AC3                     OR     AL,BL
FEC1   EE                       OUT    DX,AL              ;OUTPUT BYTE ; OUTPUT BYTE
FEC2   D1F8                     SAR    AX,1               ;SHIFT FOR NEXT BIT
FEC4   A3AB00         R         MOV    WORDDOT,AX         ;AND SAVE WORD FOR NEXT
                                                          CYCLE
FEC7   C3                       RET
FEC8   8A1EAE00       R  INBYTE: MOV   BL,STATUS
FECC   8AFB                     MOV    BH,BL              ;SEE IF USER IN OUTPUT MODE
FECE   80E301                   AND    BL,01H
FED1   7431                     JZ     CKIN               ;NO, GO TO CKIN
FED3   FE06AA00       R         INC    OUTCYC             ;IN OUTPUT MODE, INCREMENT
                                                          BITS OUT
FED7   803EAA000A     R         CMP    OUTCYC,10          ;OUTPUT 10 BITS?
FEDC   7515                     JNE    BRET               ;NO RETURN
FEDE   C606AE000090   R         MOV    STATUS,00H         ;YES, RESET STATUS AND
FEE4   BB44FE         R         MOV    BX,OFFSET          ;SET UP RETURN
                                       (CGROUP:CORT)
FEE7   8926A700       R  RSST:  MOV    STACKP,SP          ;FOR CHARGE-OUT OR CHARGE-
                                                          IN
FEEB   83C414                   ADD    SP,20
FEEE   53                       PUSH   BX
FEEF   8B26A700       R         MOV    SP,STACKP
FEF3   59                BRET:  POP    CX
FEF4   8926A700       R         MOV    STACKP,SP          ;SET UP REGISTERS FOR USER 1
FEF8   33C0                     XOR    AX,AX
FEFA   8ED0                     MOV    SS,AX
FEFC   8ED8                     MOV    DS,AX
FEFE   8B26A700       R         MOV    SP,STACKP
FF02   51                       PUSH   CX
FF03   C3                       RET
FF04   8ADF              CKIN:  MOV    BL,BH              ;SEE IF IN INPUT MODE
FF06   80E302                   AND    BL,02H             ;IF NOT, RETURN (THRU BRET)
FF09   74E8                     JZ     BRET
FF0B   EC                       IN     AL,DX              ;INPUT AGAIN & VERIFY VALID
                                                          DATE
FF0C   3AC1                     CMP    AL,CL              ;VALID,
FF0E   7408                     JZ     BITGD              ;YES, BIT IS GOOD
FF10   800EAE008090   R         OR     STATUS,80H         ;NO, BIT "ERROR" IN STATUS
FF16   EBDB                     JMP    BRET
FF18   80E180            BITGD: AND    CL,80H             ;WAITING FOR START BIT?
FF1B   80E704                   AND    BH,04H
FF1E   7435                     JZ     WAITST             ;YES, GO TO WAITST
FF20   A0AD00         R         MOV    AL,BYTEIN          ;GET BYTE SO FAR
FF23   D0E8                     SHR    AL,1               ;SHIFT ONCE FOR NEW BIT
FF25   0AC1                     OR     AL,CL
FF27   A2AD00         R         MOV    BYTEIN,AL          ;SAVE BYTE IN
FF2A   FE06A900       R         INC    INCYCL
FF2E   803EA90008     R         CMP    INCYCL,8           ;SEE IF 8 BITS IN
FF33   75BE                     JNE    BRET               ;--NO
FF35   C606A9000090   R         MOV    INCYCL,0           ;YES RESET COUNT OF BITS IN
FF3B   A0AE00         R         MOV    AL,STATUS
FF3E   2480                     AND    AL,80H             ;SEE IF BAD BIT IN MIDDLE
FF40   7408                     JZ     DELFI              ;--NO, CHARACTER GOOD,
FF42   C606AE000290   R         MOV    STATUS,2           ;BAD UNIT, RESET STATUS AND
FF48   EBA9                     JMP    BRET
FF4A   C606AE000090   R  DELFI: MOV    STATUS,0           ;RESET STATUS
FF50   BB2DFE         R         MOV    BX,OFFSET
                                       (CGROUP:CIRT)
FF53   EB92                     JMP    RSST               ;PREPARE FOR RETURN
FF55   0AC9              WAITST: OR    CL,CL              ;SEE IF START BIT IN
FF57   759A                     JNZ    BRET               ;--NOT YET
FF59   C606AE000690   R         MOV    STATUS,06H         ;--YES, RESET STATUS
FF5F   EB92                     JMP    BRET
FF61   891E0000       R  SVREG: MOV    BL1,BX
FF65   5B                       POP    BX                 ;SAVE REGISTERS
FF66   50                       PUSH   AX
FF67   FF360000       R         PUSH   BL1
FF6B   51                       PUSH   CX
```

Listing 1 continued on page 58



IT'S THE THOUGHT THAT COUNTS

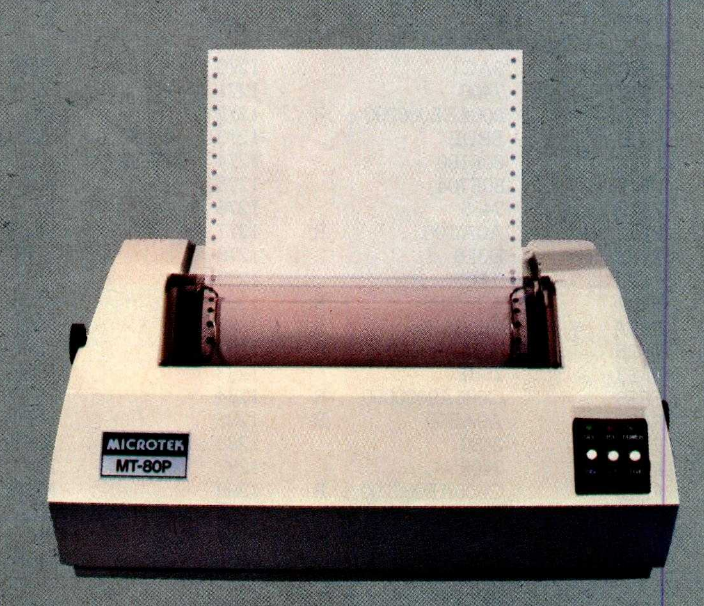
The Microtek MT-80 *looks* like a few other alphanumeric line printers on the market today. But there *is* a difference.

Our versatile, low-cost MT-80 has been designed with a more powerful brain resulting in more advanced features and more dependable performance. We believe our printer is so reliable that we offer you an incredible 365 days warranty.

If you want dependable performance, fast factory service and a low price, look for the Microtek label. The brain behind our printer really makes the difference. It's the thought that counts.

LOADED WITH INNOVATIONS

- 40, 80 or 120 columns (software selectable)
- Non-thermal paper, pin feed
- 125 CPS, 70 lines per minute
- 9 × 7 dot matrix
- Vertical format unit
- 96-character ASCII (upper and lower case)
- Adjustable forms width to 9½″
- Parallel and serial (RS-232C) interfaces available



MICROTEK

For more information contact:

MICROTEK, Inc.
9514 Chesapeake Drive
San Diego, CA 92123
Tel. (714) 278-0633

Listing 1: *Multitasking code that allows two users to be served by the same processor, seemingly simultaneously. Here it is written in assembly language for the 16-bit Intel 8088 microprocessor. When no user requires service, the processor executes a tight loop. When some operation must be carried out, this routine supervises the process. Various I/O operations and counter events cause this code to be entered. The algorithm is shown in flowchart form in figure 4.*

Hexadecimal Address	Hexadecimal Code		Label	Instruction Mnemonic	Operand	Commentary
FE28	EB5990			JMP	USER?	
FE2B	EBFE		IORTI:	JMP	IORTI	;LOOPS TO ITSELF
FE2D	A0AD00	R	CIRT:	MOV	AL,BYTEIN	;RETURNS HERE
FE30	C3			RET		
FE31	50		CO:	PUSH	AX	;SAVE REGISTERS
FE32	D1E0			SAL	AX,1	;SHIFT LEFT TO SET
FE34	0D000F			OR	AX,0F00H	;OR TO SET UP STOP
FE37	A3AB00	R		MOV	WORDOT,AX	
FE3A	C606AA000090	R		MOV	OUTCYC,0	;RESET OUTCYCLES
FE40	B001			MOV	AL,1	;SET STATUS TO OUT
FE42	EBD8			JMP	COMP	;SEE IF NEED TO GO
FE44	58		CORT:	POP	AX	
FE45	C3			RET		
FE46	E81801		TIMEOUT:	CALL	SVREG	;SAVE REGISTERS
FE49	BA0200			MOV	DX,INPORT	
FE4C	EC			IN	AL,DX	;INPUT USER 1
FE4D	8AE0			MOV	AH,AL	
FE4F	BA01F0			MOV	DX,INPRT2	
FE52	EC			IN	AL,DX	;INPUT USER 2
FE53	50			PUSH	AX	;SAVE FOR FUTURE USE
FE54	8BC8			MOV	CX,AX	;INPUT DATA,SAVE
FE56	BA0100			MOV	DX,OUTPORT	;SET UP OUTPUT, USER 1
FE59	E85700			CALL	OUTWORD	;OUTPUT
FE5C	8926A700	R		MOV	STACKP,SP	;NEXT BIT OR STOP BIT
FE60	BA00F0			MOV	DX,OUTPT2	
FE63	B80800			MOV	AX,00008H	
FE66	8ED0			MOV	SS,AX	;SET UP SEGMENTS FOR USER 2
FE68	B82000			MOV	AX,20H	
FE6B	8ED8			MOV	DS,AX	
FE6D	8B26A700	R		MOV	SP,STACKP	
FE71	E83F00			CALL	OUTWORD	;OUTPUT NEXT BIT OR CHIP BIT
FE74	BA01F0			MOV	DX,INPRT2	
FE77	E84E00			CALL	INBYTE	;PROCESS INPUT/OUTPUT CYCLES, USER 2
FE7A	59			POP	CX	;RESTORE INPUTS
FE7B	8ACD			MOV	CL,CH	
FE7D	BA0200			MOV	DX,INPORT	;PROCESS INPUT/OUTPUT ,USER2
FE80	E84500			CALL	INBYTE	
FE83	A0AE00	R	USER?:	MOV	AL,STATUS	;DETERMINE WHICH USER TO RESTORE
FE86	2403			AND	AL,03H	
FE88	7406			JZ	CKU2	;IF UI IN CO OR CI
FE8A	B80800			MOV	AX,00008H	;UI IN CO OR CI
FE8D	EB0F90			JMP	PRETI	;GO TO U2
FE90	A0AE02	R	CKU2:	MOV	AL,STATS2	
FE93	2403			AND	AL,03H	
FE95	7509			JNZ	PRET	;USER 2 IN CO OR CI,RETURN TO UI
FE97	36A10C00		SWUS:	MOV	AX,SS:STACKS	
FE9B	350800			XOR	AX,0008H	;SWITCH USER FROM PREVIOUS
FE9E	8ED0		PRETI:	MOV	SS,AX	
FEA0	D1E0			SAL	AX,1	
FEA2	D1E0			MOV	SP,STACKP	
FEA	8ED8			SAL	A,1	
FEA6	8B26A700	R		MOV	DS,AX	;SET UP STOCK & DATA SEG
FEAA	07			POP	ES	
FEAB	5D			POP	BP	;RESTORE REGISTERS
FEAC	5F			POP	DI	
FEAD	5E			POP	SI	
FEAE	5A			POP	DX	
FEAF	59			POP	CX	
FEB0	5B			POP	BX	
FEB1	58			POP	AX	

Listing 1 continued on page 56

people who play the computer specify Verbatim®

Virtuoso performers at computer keyboards deserve the ultimate in recording quality. That's why you should specify Verbatim brand diskettes, minidisks, cartridges and data cassettes for your computer or word processing system.

At Verbatim, the whole message is quality. We specialize in digital data recording media and have become the world leader by setting the standards for flawless, dropout-free magnetic media. Every size, every format, and available everywhere. Order them from your computer supplies dealer.

Simply specify Verbatim.

For the name of your nearest Verbatim distributor, call:

800-538-1793
In California call:
(408) 737-7771 collect

Verbatim Corporation
323 Soquel Way
Sunnyvale, CA 94086

In Europe:
Verbatim S.A.
Case Postale 296
1215 Genève 15
Switzerland
Telephone: 41(22) 34-90-55
Telex: 22647 ITGE CH.



result to the position within the segment.

For example, if the processor was instructed to load the byte at hexadecimal location 154 within the segment, and the data-segment register contained the hexadecimal value 14, the resulting *effective* address is computed as:

$$14_{16} \times 10_{16} = 140_{16}$$
(data segment value times 16)
$$+\ 154_{16}$$
$$294_{16}$$
(location within the segment)

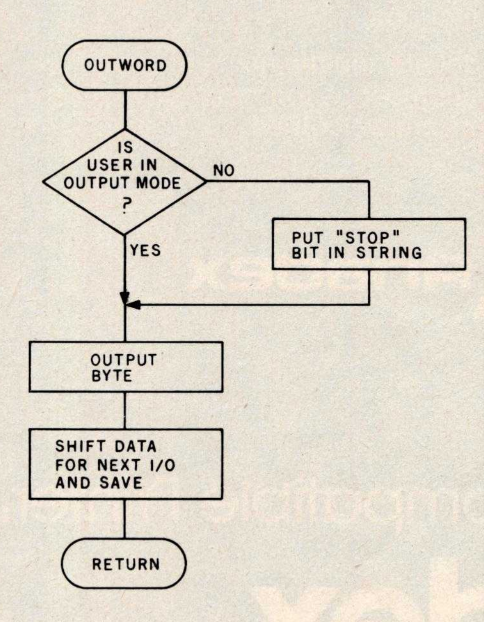


Figure 4c: *Routine to send output from one of the users.*

Therefore, if I want the processor to access user 1's pushdown-stack buffers, I set the stack-segment register equal to 0. When I access the stack buffer, which is located from hexadecimal addresses 10 to 7F, the effective address computed will still be hexadecimal 10 to 7F.

If I want to access user 2's stack, I set the stack-segment register to a value of 8. When the processor computes the effective address, it will multiply the stack-segment value by 16 and add the product to the location within the segment. This means that user 2's stack buffer will be correctly addressed in hexadecimal locations 90 thru FF while allowing the program to use the same address values used to access user 1's stack.

The program buffers are handled in essentially the same way. For user 1, the data-segment register and extra-segment register are set to 0, and the program is written to address the buffers as hexadecimal addresses 1000 to 11FF. When I want to access user 2's program, I load the segment registers with the hexadecimal value 20. When the processor computes the effective address, it will come up with hexadecimal addresses 1200 thru 13FF, which is what I want.

Since the interpreter itself does not modify values in the segment registers, the interpreter never knows which user-task it is currently working on, but it does not care. With the proper loading of the segment registers by the *operating system*, the correct buffer of the current user will be used.

Using this feature, the 8088 processor can work for several users, switching between them by manipulating only the segment registers. Because of memory limitations, the maximum practical number of users on the system described here is only two. However, the programs could just as easily serve three or four users as two users.

Software Modifications

There are two other software routines that must be specifically modified to handle multiprocessing. The initiating sequence of code that is executed when a restart signal is received must be changed. Also, an interrupt handler for the nonmaskable interrupt generated by the timer of the 8155 must be added.

When the microprocessor is reset, the initiating routine initializes all the I/O ports and sends out the initial stop-bit signal to the terminals. It also sets up user 2's stack area so that the processor will begin execution at the START routine when it is through processing user 1. After setting the correct data-transfer rate for the user terminals, the initiating routine jumps to START for user 1. The initiating routine is required so that the registers, buffer areas, and the stacks will be set up properly for each user before any other processing begins.

Once normal processing has begun, the routine that handles the timer-out

Text continued on page 58

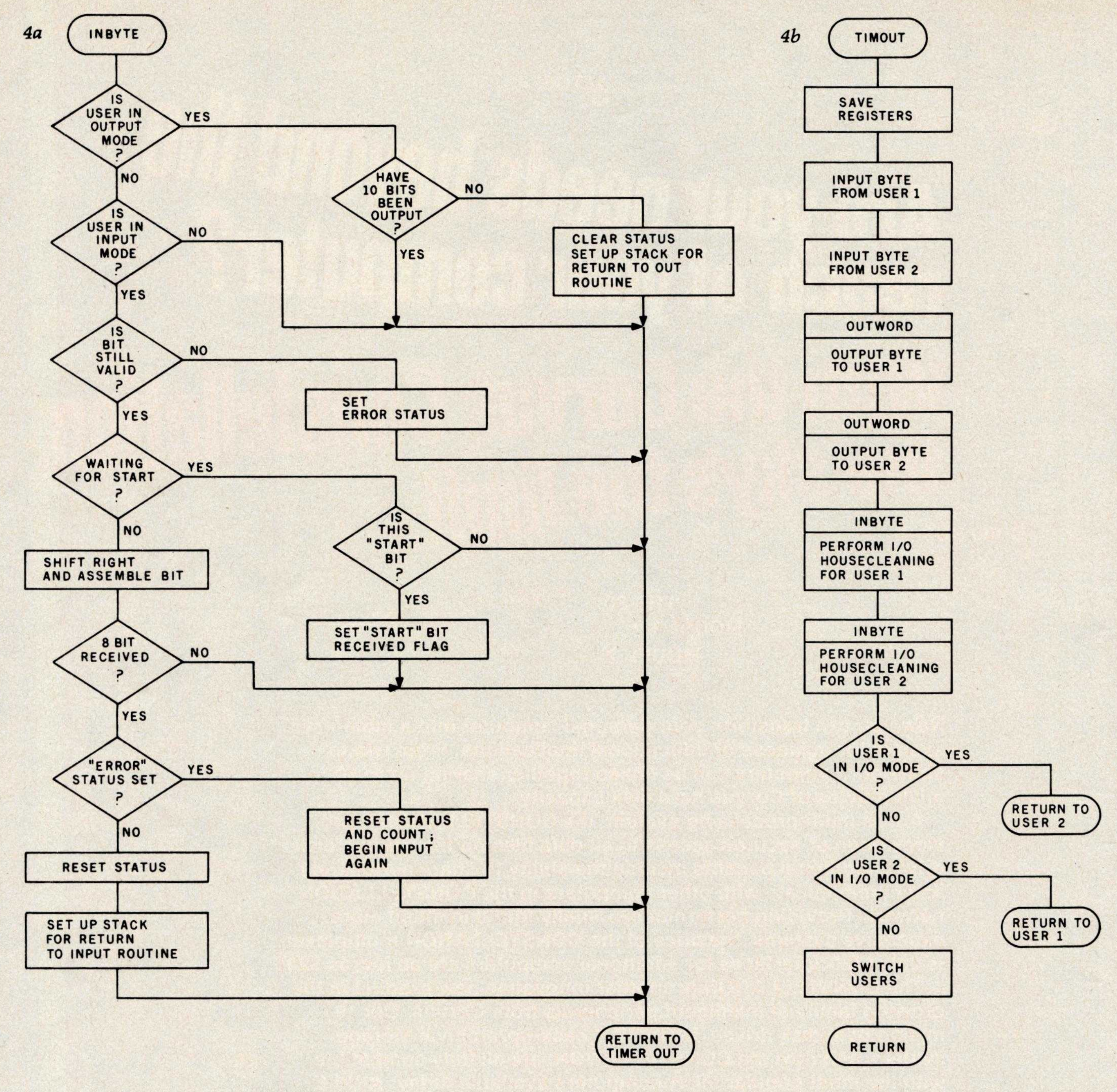


Figure 4: *Flowchart of the multitasking routine of listing 1, which divides the resources of the 8088 system between the two users. (4a) Routine to receive input from one of the users. (4b) Routine to handle timing out of the time-arbitration counter.*

belonging to one user in a relative mode, and to modify the actual memory area being accessed by just changing the segment registers to point to the area containing the specific user-task we currently want to work with.

Specifically, the 256 bytes of user memory in the 8155 are divided into two areas, one for each user, to provide the required stack buffers. The 1 K bytes of user memory in the 8185 are divided into four areas for each user. User 1's stack buffer goes from hexadecimal locations 10 to 7F. User 2's stack buffer goes from hexadecimal locations 90 to FF.

Corresponding areas in the two stack buffers are separated by hexadecimal 80 bytes. Each of the buffers in the program buffer area of memory (contained in the 8185) is separated by hexadecimal 200 bytes. These memory areas are shown in figure 3.

When the microprocessor needs to access a given area in memory, the effective address of the memory that is to be accessed is computed by multiplying the appropriate segment register by 16, and then adding the

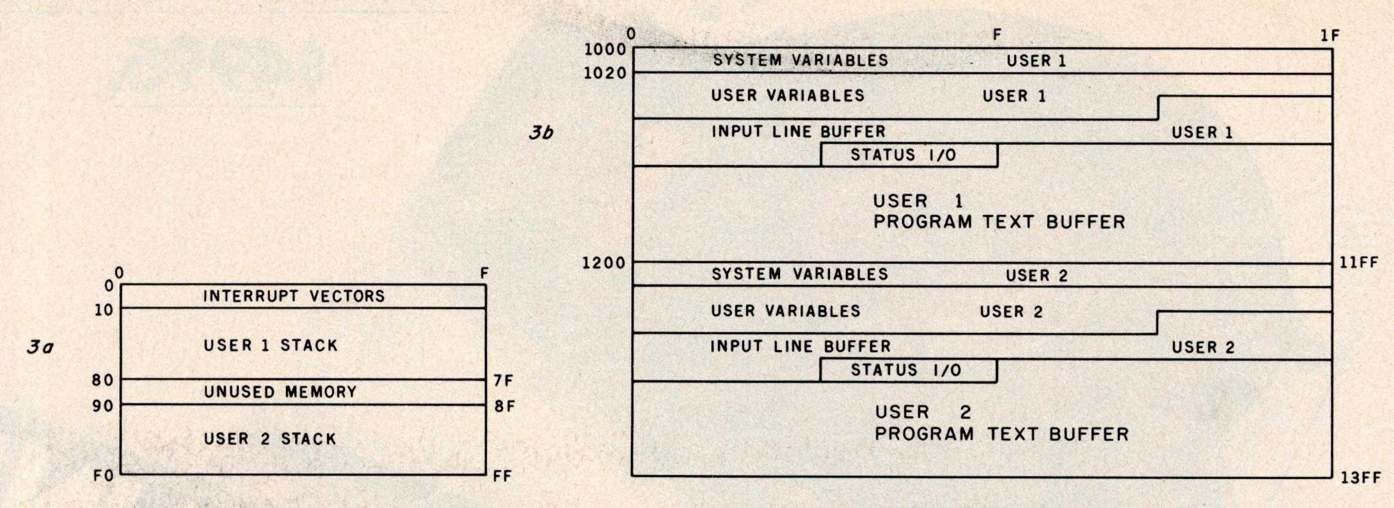


Figure 3: *Map of memory use of the 8088 multi-user operating system. Programmable memory from hexadecimal addresses 00 thru FF is contained in the 8155 integrated circuit and is used chiefly to hold the pushdown stack for each user. Memory from hexadecimal locations 1000 thru 13FF is in the 8185 device, and stores various data belonging to the two user-tasks. Memory from hexadecimal addresses 0F800 to 0FFFF takes the form of EPROM in the 8755A, which stores the operating system.*

the 8086, addresses all memory locations using one of four *segment registers*.

All of the jumps and subroutine calls within a program are made relative to the current position of the instruction pointer. Hence, the jumps and calls are not specific to the memory segment where a given section of program code is placed. The code can be moved from place to place within memory, and will still execute properly if the segment registers are set up correctly.

It is also this segmenting feature that allows us to write the BASIC interpreter in such a way as to address the buffers and programs



Suddenly, S-100 microcomputer systems can easily handle 100 million bytes. Because Morrow Designs™ now offers the first 26 megabyte hard disk memory for S-100 systems—the DISCUS M26™ Hard Disk System.

It has 26 megabytes of useable memory (29 megabytes unformatted). And it's expandable to 104 megabytes.

The DISCUS M26™ system is delivered complete—a 26 megabyte hard disk drive, controller, cables and operating system—for just $4995. Up to three additional drives can be added, $4495 apiece.

The DISCUS M26™ system features the Shugart SA4008 Winchester-type sealed media hard disk drive, in a handsome metal cabinet with fan and power supply.

The single-board S-100 controller incorporates intelligence to supervise all data transfers, communicating with the CPU via three I/O ports (command, status, and data). The controller has the ability to generate interrupts at the completion of each command to increase system throughput. There is a 512 byte sector buffer on-board. And each sector can be individually write-protected for data base security.

The operating system furnished with DISCUS M26™ systems is the widely accepted CP/M* 2.0.

See the biggest, most cost-efficient memory ever introduced for S-100 systems, now at your local computer shop. If unavailable locally, write Morrow Designs,™ 5221 Central Avenue, Richmond, CA 94804. Or call (415) 524-2101, weekdays 10-5 Pacific Time.

*CP/M is a trademark of Digital Research.

MORROW DESIGNS™
Thinker Toys™

Circle 18 on inquiry card.

Software with Manual / Manual Alone

☐ **XYBASIC** Interactive Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in Integer, Extended and ROMable versions.
Integer Disk or Integer ROMable .... **$295/$25**
Extended Disk or Extended ROMable ..... **$395/$25**

☐ **SMAL/80** Structured Macro Assembled Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... **$75/$15**

☐ Ⓜ †† **SELECTOR III-C2** — Data Base Processor to create and maintain multi Key data bases. Prints formatted sorted reports with numerical summaries or mailing labels. Comes with sample applications, including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC-2. Supplied in source ... **$295/$20**

Lower Price!

☐ **GLECTOR** — General Ledger option to SELECTOR III-C2. Interactive system provides for customized COA. Unique chart of transaction types insure proper double entry bookkeeping. Generates balance sheets, P&L statements and journals. Two year record allows for statement of changes in financial position report. Supplied in source. Requires SELECTOR III-C2, CBASIC-2 and 52K system .... **$250/$25**

☐ **CPM/374X** — Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... **$195/$10**

☐ Ⓜ **BASIC UTILITY DISK** — Consists of: (1) CRUNCH-14 — Compacting utility to reduce the size and increase the speed of programs in Microsoft BASIC and TRS-80 BASIC. (2) DPFUN — Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation ... **$50/$35**

☐ Ⓜ **STRING/80** — Character string handling plus routines for direct CP/M BDOS calls from FORTRAN and other compatible Microsoft languages. The utility library contains routines that enable programs to chain to a COM file, retrieve command line parameters, and search file directories with full wild card facilities. Supplied as linkable modules in Microsoft format. .... **$95/$20**
STRING/80 source code available separately **$295/n.a.**

NEW!

☐ Ⓜ **THE STRING BIT** — FORTRAN character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source .... **$45/$15**

☐ Ⓜ **BSTAM** — Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansion to send ★.COM, etc. 9600 baud with wire. 300 baud with phone connection. **Both** ends need one. Standard and Ⓜ versions can talk to one another. .... **$150/$5**

★★★★★★★★

SUNDRIES & NOTIONS

☐ **HEAD CLEANING DISKETTE** — Cleans the drive Read/Write head in 30 seconds. Diskette absorbs loose oxide particles, fingerprints, and other foreign particles that might hinder the performance of the drive head. Lasts at least 3 months with daily use. Specify 5″ or 8″ .... **$20 ea./$45 for 3**

☐ **FLIPPY DISK KIT** — Template and instructions to modify single sided 5¼″ diskettes for use of second side in single sided drives **$12.50**

☐ **FLOPPY SAVER** Protection for center holes of 5¼″ floppy disks. Only 1 needed per diskette. Kit contains centering post, pressure tool, tough 7-mil mylar reinforcing rings. Installation tools and rings for 25 diskettes **$14.95**
Re-orders of rings only **$7.95**

☐ **PASCAL USER MANUAL AND REPORT** — By Jensen and Wirth. The standard textbook on the language. Recommended for use by Pascal/Z, Pascal/M and Pascal/MT users **$8**

☐ **THE C PROGRAMMING LANGUAGE** — By Kernighan and Ritchie. The standard textbook on the language. Recommended for use by BDS C, tiny C, and Whitesmiths C users **$12**



*CP/M and MP/M are trademarks of Digital Research.
Z80 is a trademark of Zilog, Inc.
UNIX is a trademark of Bell Laboratories.
WHATSIT? is a trademark of Computer Headware.
Electric Pencil is a trademark of Michael Shrayer Software.
TRS-80 is a trademark of Tandy Corp.
Pascal/M is a trademark of Sorcim.

†CP/M for Heath and TRS-80 Model I are modified and must use specially compiled versions of system and applications software.

††Recommended system configuration consists of 48K CP/M, 2 full size disk drives, 24 x 80 CRT and 132 column printer.

Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers.

Ⓛ User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

Ⓘ Ⓧ This product Includes/eXcludes the language manual recommended in Sundries and Notions.

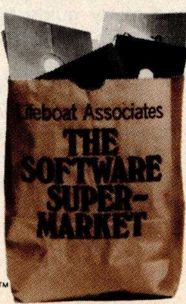
VISA · master charge

Orders must specify disk systems and formats: e.g. North Star single, double or quad density, IBM single or 2D/256, Altair, Helios II, Micropolis Mod I or II, 5¼″ soft sector (Micro iCOM/SD Systems Dynabyte), etc.

Prices F.O.B. New York. Shipping, handling and C.O.D. charges extra.

Manual cost applicable against price of subsequent software purchase.

The sale of each proprietary software package conveys a license for use on one system only.



™The Software Supermarket is a trademark of Lifeboat Associates

HIS CONTRIBUTIONS WERE MADE POSSIBLE BY YOURS.

AIR MONITORING LABORATORY

When you give to the United Negro College Fund, you help support 41 private, four-year colleges and graduate schools. Colleges that could be training a black professional you may need someday.

Send your check to: United Negro College Fund, Box B, 500 E. 62nd Street, New York, New York 10021. We're not asking for a handout, just a hand.

No one can do it alone.

GIVE TO THE UNITED NEGRO COLLEGE FUND.

A mind is a terrible thing to waste.

A public service of this magazine and The Advertising Council.



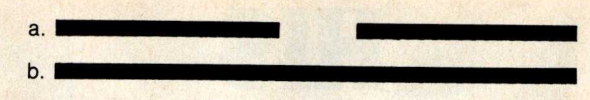


Figure 1: *Broken and continuous line segments, the two states used by the* I Ching *hexagrams.*

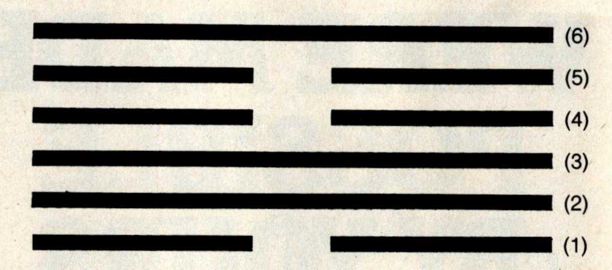


Figure 2: *A typical* I Ching *hexagram. The six positions are numbered from bottom to top. The top three positions form the upper trigram; the bottom positions form the lower trigram. Meaning is attached to both the state, broken or continuous, and the position of the lines.*

Text continued from page 96:
of six lines with chingish meaning attached to binary state and to position, also contains an upper and lower trigram. Each trigram has a meaning, not only independently but in relation to the other trigram.

Since the "magic" resides in your ability to read your own hexagram, it is important that you clearly understand all the different ways to read it. This is why I am carrying on at such length, and why the texts of the *I Ching*, while there are only sixty-four of them, are capable of doing an incredible job of fortune-hinting.

The *I Ching* is a book of texts, each one of them describing, explaining, and commenting on a particular hexagram. Each hexagram has a name and a meaning as a whole, but so does each of the trigrams and each of the six lines, both in the context of its trigram and of the hexagram. When you cast a hexagram, the next step is to consult the texts for its meaning to see how it applies to your particular case.

There are many good translations of *I Ching* texts available at most libraries, and there are one or two inexpensive paperback editions of *I Ching* texts. Ask your local book dealer; some references are listed at the end of this article. There are several translations, and some are more structured than others. I prefer any translation edition by Legge over the one introduced by Jung, because the latter unfortunately fleshes out the textual bones with a lot of typical Jungian verbosity.

Personally, I prefer *using* the *I Ching* to talking about it. Using the program of listing 1, along with the simplest *I Ching* text you can find at the library or paperback bookstore, is going to give you an unending supply of mental entertainment, and perhaps bring on the surprise of an occasional insight.

Rules for using the program are very simple. First, think of some question you want to ask the "oracle." Be reasonably serious about it, as the "answers" will be involved and you will have to *want* to think about what they really mean. Then "cast" your hexagram by pressing the Enter (or Return) key at the appropriate time during execution of the program. Concentrate on the question as the hexagram is cast, and you will receive an output of your personal hexagram in response. The hexagram will be accompanied by a numerical code which should help you to look up the proper text, depending on which edition of the *I Ching* you are using.

Read the text written for your hexagram and study the descriptive and advisory texts for each line. You will be surprised at what you may learn about your problem and about yourself.

If you cast a hexagram while in the wrong frame of mind, don't hesitate to erase it and try again. Concentration is crucial, and, while a cast of tortoiseshell wands can't be erased, a cast by computer can be returned to nonexistence by merely pressing the Enter key in order to try again.■

Notes on the *I Ching*

The program listed here is a first approximation (good enough "to attract the attention of the opposite sex," especially in California) of a more detailed method of reading the I Ching. *In this method, which is listed in most translations of the* I Ching *book, a second hexagram can be generated using "moving lines," which form under certain conditions. If a hexagram contains one or more moving lines, a second hexagram that is read differently can be generated by changing each moving line to its opposite form, that is, from solid to broken and vice versa. (For those interested, each line randomly chosen has a one-quarter chance of being a moving line. See the preface to Legge's translation for more information).*

Quite apart from its purported mystical use, the I Ching *can be seen with a more Western view. Some psychologists, and notably Carl Jung, have interpreted the* I Ching *as a sounding board for the subconscious. Jung's idea is, given that the interpretations of the* I Ching *are vaguely phrased, the person interpreting a hexagram will unconsciously read it in terms of the subconscious' desires. I find that this interpretation has some practical value when using the* I Ching *as a decision-making device, although some people would say that it merely transfers the motive force of the* I Ching *from one supernatural realm to another....*
GW

References

1. Baynes, Cary F, *The I Ching: or Book of Changes*, Richard Wilhelm translation rendered into English; foreword by Carl Jung. Princeton University Press, Princeton NJ, 1967.
2. Hook, Diana, *The I Ching and Mankind*, Routledge and Kegan Paul, London and Boston, 1975.
3. Legge, James (translator), *The I Ching*, Dover Publications, New York, second edition, 1963.
4. Legge, James, (translator), *The I Ching: Book of Changes*, edited, with introduction and study guide by Ch'u Chai with Winburg Chai, University Books, Secaucus NJ 1964.
5. Liu, Da, *I Ching Coin Prediction*, Harper and Row, New York, 1975.
6. Wilhelm, Helmut, *Heaven, Earth and Man in the Book of Changes: Seven Eranos Lectures*, University of Washington Press, Seattle, 1977.

SYNCHRO-SOUND

The ORIGINAL Computer People who KNOW Computers and offer EVERYTHING you need in Small Computer Systems

A PERFECT SUPER SPECIAL MATCHED PAIR!



Texas Instrument 810 Multi Copy Impact Printer
150 characters per sec.
bi-directional printing

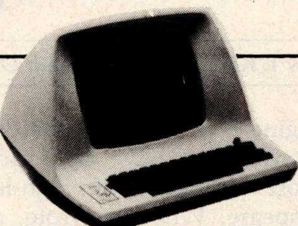
Intertec Super Brain Computer Terminal
Dble. Density Dual Mini-Floppies, CPM based Development or Business System

ONLY $3995.

TERMINALS



ADDS Regent 25



LEAR SIEGLER
ADM 3A
ADM 31
ADM 42



HAZELTINE

1400	1500	Mod 1
1410	1510	Edit
1420	1520	

PRINTERS



QUME Sprint
5/45 KSR
5/55



DECwriter IV
LA 34

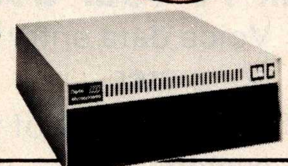
TELETYPE
43



CENTRONICS

779-2	703-0
700-2	730

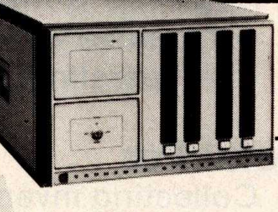
COMPUTERS



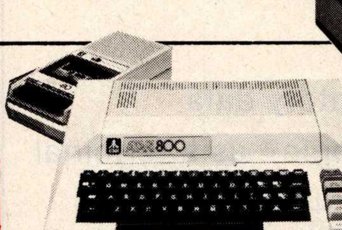
DIGITAL SYSTEMS
DSC 2
Dble. Density
Dual Drive Disk



NORTHSTAR
HORIZON II
HORIZON II Quad



CROMEMCO
System 3



ATARI
400
800

MORE SPECIALS

Okidata SL125	$2595.00
Okidata SL300	2995.00
Persci 277 Dble Density	1395.00
Imsai PCS 80/15	499.00
Televideo 912, 920	CALL
Livermore Accoustic Coupler	$249.00
Centronics Micro Printer	349.00
5" Scotch Diskette Box	34.95
8" Scotch Diskette Box	39.95

MANY OF OUR PRICES ARE TOO LOW TO ADVERTISE. PLEASE CALL OR WRITE

We carry a full line of Alpha-Micro Products.
We have a full staff of Programmers and Computer Consultants to design, configure and deliver a Turnkey Computer System to meet your specific requirements.



SYNCHRO-SOUND ENTERPRISES, INC.
THE COMPUTER PEOPLE
193-25 Jamaica Ave., Jamaica, New York 11423 • TWX 710-582-5886

PHONE ORDERS, CALL:
New York-212/468-7067
Los Angeles-213/628-1808
Chicago-312/641-3010
Dallas-214/742-6090

Circle 60 on inquiry card.

Technical Forum

MicroShakespeare

Andrew E Kalnik, 3201 Wamath Dr, Charlotte NC 28210

Imagine how many of the concepts and problems of microprocessing have been addressed by the world's foremost exponent of high-level language: William Shakespeare. What he wrote, almost 400 (hexadecimal 190) years ago, deals directly with the emotions aroused in our half-happy, half-feverish engagement in the art of computing.

For example, anyone who has struggled through a night of debugging, fighting the false starts, the glitched-up thinking channels, the "it's-two-thirty-already-won't-anything-ever-work-again?" kind of anxiety will know that the bearded bard said it truly in *Richard III*:

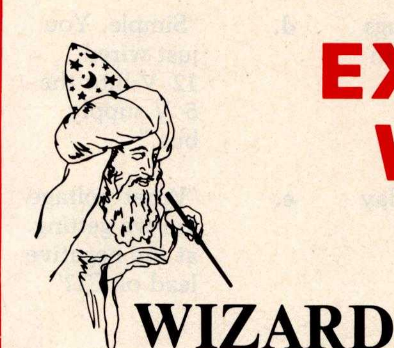
> "Oh I have pass'd a miserable night
> So full of ugly sights, of ghostly dreams,
> That . . .
> I would not spend another such a night
> Though 'twere to buy a world of happy days. . . ."

Here is a quiz to test your knowledge of microcomputing wares, soft and hard, and to do a quick comparison of today's terms with the high style of Elizabethan theater.

Just match the letters of each of the modern phrases with the most suitable numbered Shakespearean quotes. No one is going to know how you came out, unless you tell. The answers and ratings are on pages 108 and 110.

1. ( )	. . . The needful bits . . . *Measure for Measure,* I/iii (Act I, scene 3)	**a.**	"GIGO!"
2. ( )	. . . one that wouldst be a bawd . . . *King Lear,* II/ii	**b.**	"We should have one more position in each byte for parity checking."
3. ( )	. . . superfluous branches we lop away . . . *Richard II,* III/iv	**c.**	"This program is driving me up the wall."

APPLE OWNERS — EXPAND YOUR SYSTEM WITH 8" FLOPPY DISK DRIVES FROM *WIZARD*!



Many software programs are restricted by the 116 K available on the 5" disk drives now on the market. Some business programs require 12 or more diskettes, which can be both confusing and error inducing.

***WIZARD* offers four solutions:**

"***WIZARD*** 1 + 1"	: single 8" drive system; 256 K	$1695.
"***WIZARD*** 2 + 2"	: two 8" drive system; 516 K	$2495.
"***WIZARD*** PLUS"	: two 8" drives, double sided; over 1 megabyte	$3150.
"***WIZARD*** 10"	: 10 megabyte Winchester hard disk drive, formatted as one file, or as 24 individual files	$4795.

All systems are ready to run, fully assembled and tested, and include:

SHUGART full size 8" floppy disk drive(s).

Controller Card for your Apple (48K RAM required)

All interface software, cables, connectors, cabinet and power supply.

ONE YEAR parts and labor warranty from defects in material and workmanship.

WATCH FOR NEW *WIZARD* PRODUCTS FROM D&T ELECTRONICS:
we are currently developing other hardware and business software.

ALL SYSTEMS AVAILABLE NOW (stock to two weeks).

SEE YOUR LOCAL APPLE DEALER, OR ORDER FROM:

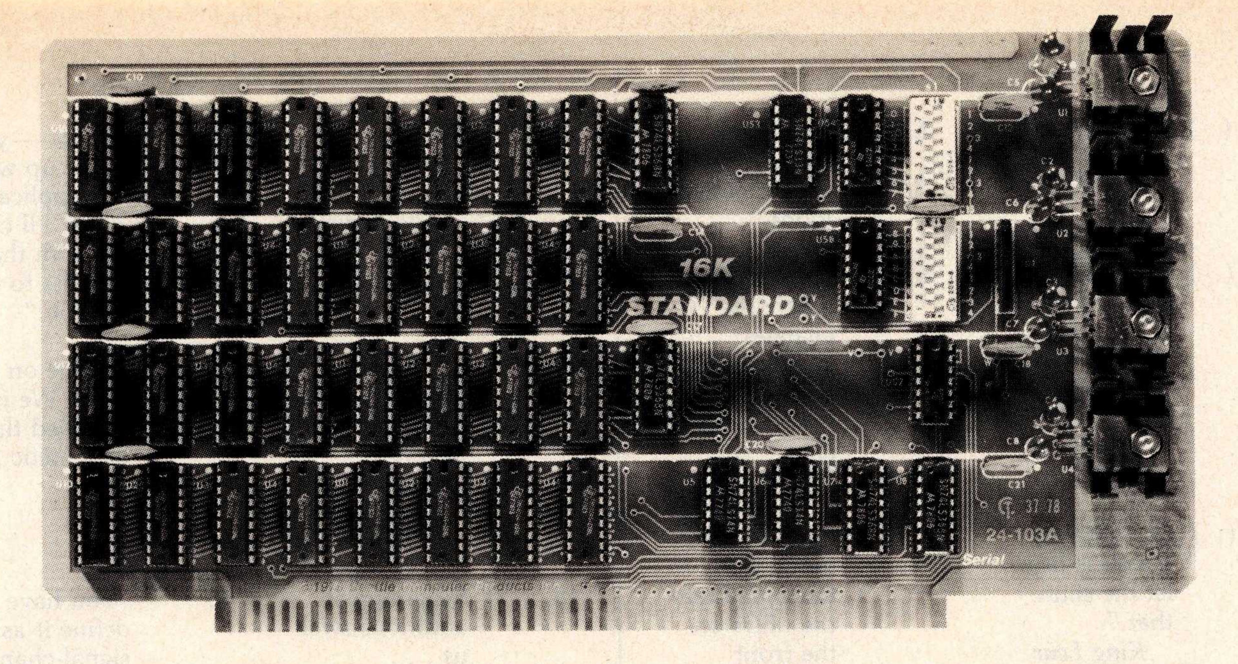
COMPUTER DISTRIBUTORS, INC.
PO BOX 9194
Austin, TX 78766
(512) 345-9729
DEALER INQUIRIES INVITED

SOFTWARE: We have business software to run on these expanded capacity systems; please send for our list.
If you are a software writer and have programs currently on 5" that would benefit from the expanded capacity of our 8" systems, we would like to hear from you.

WIZARD is a registered trademark of D&T Electronics, Inc.
Apple is a registered trademark of Apple Computer, Inc.

Circle 62 on inquiry card.

4. ( )	Ho! Such bugs and goblins in my life! *Hamlet*, V/ii	**d.**	"Simple. You just wired 12 V into the 5 V supply bus."
5. ( )	It is bright day that brings forth the adder. *Julius Caesar*, IV/iii	**e.**	"What voltage are we getting at the negative lead of C1?"
6. ( )	Something failing in him that should compare . . . *Cymbeline*, I/i	**f.**	"I don't trust GOTO any more than you do. My students get into trouble every time they use it."
7. ( )	Tellest thou me of 'ifs'? *Richard III*, III/iv	**g.**	"I need a good text processor."
8. ( )	You have done that you should be sorry for. *Julius Caesar*, IV/iii	**h.**	"Only you and I will ever know what's in the read-only memory."
9. ( )	. . . And must we be divided? *Richard II*, V/i	**i.**	"Are you telling me I've loaded the wrong value in the accumulator to start the count?"
10. ( )	I will be correspondent to command. *The Tempest*, I/ii	**j.**	"It's only a thousand bytes; we can always toggle them in by hand."
11. ( )	We but teach Bloody instructions, which, being taught, return To plague the inventor. *Macbeth*, I/vii	**k.**	"We're just not jumping from the test into the subroutine."



16K RAM

Fully Static
300 nsec. for 4 Mhz. Z-80

$265

The Model 24-103 "STANDARD RAM" was designed for the smaller system which does not require bank select. It has been in production since late 1978 and has earned an enviable record for reliability. Although it does not have some of the options of the commercial cards listed below, its manufacturing quality has not been cut in any way. The card has DIP switch addressing — any continuous 16K on 4K boundaries. All inputs are buffered and it comes fully assembled, tested and guaranteed for one year. Prices for the card with 300 nsec. chips start at $265 and drop to $225 for quantities 5-9. Add $30 per board for 250 nsec. chips for faster CPU clock speeds.

OTHER S-100 BUS STATIC RAMS

16K PLUS

This board has been sold primarily to dealers/system integrators during the past 20 months. It has become the reliability standard against which other boards are compared. It is fully static, 16K by 8 bits, and a premium quality product featuring Schmitt triggers for all signal inputs. The board has been optimized for the Cromemco systems using output port 40H for its bank select. It also has start-up options which allow the board to come up in either the enabled or disabled condition. It is addressable by DIP switches in any continuous 16K on 4K boundaries. Prices with 300 nsec. chips (for 4 Mhz. Z-80 systems): 1-4, $365; 5-9, $295. Add $30 per board for 250 nsec. chips for faster CPU clock speeds.

16K APEX

This board is very similar to the PLUS card. It differs in that its bank select can use any of 256 output port addresses and it can be addressed on 16K boundaries only. Pricing is the same as for the PLUS.

8/16 RAM

This board was designed for the 1980s. It is configured as 16K by 8 bits when accessed by an 8-bit processor and configured 8K by 16 bits when used with a 16-bit processor. The configuration switching is automatic and is done by the card sampling the "Sixteen Request" signal sent out by all 16-bit CPU boards. The card has all the high noise immunity features of the PLUS and APEX as well as "extended addressing". Extended addressing is a replacement for bank select which makes use of a total of 24 address lines to give a directly addressable range of over 16 megabytes. (For older systems, a switch will cause the card to ignore the highest 8 address lines) This card ensures that your memory board purchase will not soon be obsoleted. It comes with 200 nsec. memory chips only and is guaranteed to run without wait states with our 8086 CPU using an 8 Mhz. clock. Prices: 1-4, $445; 5-9, $345.

MEMORY CHIPS

We have 4044 type 4K by 1 fully static memory chips available. See our ad in March BYTE for prices.

ALL SCP BOARDS ARE FULLY ASSEMBLED, TESTED AND GUARANTEED ONE YEAR

HOW TO ORDER

There are two ways to go. You can check with your local dealer or order directly from the factory. Bank cards, personal checks, CODs okay. There is a 10-day return privilege on factory orders. All boards are guaranteed for one year — both parts and labor. Shipped prepaid by air from stock in US and Canada. Foreign purchases — must be prepaid in US funds. Also add $10 per board for overseas air shipment.



1114 Industry Drive, Seattle, WA. 98188
(206) 575-1830

Circle 64 on inquiry card.

12. ( ) Words, words, words . . .
Hamlet, II/ii

l. "If we can, let's cut down on the nested loops."

13. ( ) Why should I write this down, that's riveted, Screwed to my memory?
Cymbeline, II/ii

m. "Sure, I know where the changes should be. I'll do the documentation later."

14. ( ) O, that way madness lies; let me shun that."
King Lear, III/iv

n. "You have too much resistance tied into the LEDs on the front panel."

15. ( ) 'Tis in my memory locked, and you yourself shall keep the key of it.
Hamlet, I/iii

o. "The number-crunching is what's really eating up processor time."

16. ( ) What error leads must err.
Cymbeline, V/v

p. "Look — you come up with the applications; I'll come up with the circuits to do the job."

17. ( ) . . . Dim register and notary of shame . . . .
Rape of Lucretia, 1. 764

q. "Come on over. We just installed the arithmetic unit."

18. ( ) Where great additions swell us . . .
Alls' Well that Ends Well, II/ii

r. "You have to define it as 1 signal-change per second."

19. ( ) Who hath measured the ground?
Henry V, III/vii

s. "Why don't we calculate the reciprocal just once, store it, and call it out to multiply with it whenever we need to later?"

20. ( ) Power, unto itself most commendable.
Coriolanus, IV/i

t. "It ought to be enough; it puts out 30 A at +5 V."

Number of Correct Matches	MicroShakespeare Rating
20	System thoroughly debugged.
17-19	One or two minor glitches still to be worked out.
13-16	Put it through an edit run.
9-12	Check the flowcharts.
5-8	Reset and restart.
4 and fewer	System crash for reasons unknown. ■

Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.

More GOTOXY

George Bolthoff, 3417 S Plaza Dr, Apt 1, Santa Ana CA 92704

I may be able to assist Carl Helmers with the problem expressed in his editorial "The Era of Off-the-Shelf Personal Computers Has Arrived" (January 1980 BYTE, pages 6 thru 10 and 93 thru 98). The problem concerned adapting the GOTOXY procedure used by the UCSD Pascal system to do cursor addressing in Mr Helmers' Computer Peripheral Corporation COPS-10 video terminal.

I offer for Mr Helmer's use the routine shown here as listing 1. It is faster than the one published in his editorial as listing 1 (page 96, January) because the UNITWRITE procedure is taken out of the loops. The error checking can also be removed, if you are careful in your programming. The routine shown here as listing 2 works on my SOROC 120 terminal. ■

Listing 1: *Pascal routine to place cursor at specified address on COPS-10 terminal.*

```
PROGRAM FGOTOXY(X,Y:INTEGER);
CONST
              HOME=30;
              DOWN=10;
            ACROSS=12;
              NULL=0;
          MAX_SIZE=80;
 VAR
     SEND:PACKED ARRAY[0..MAX_SIZE] OF 0..255;
     INDEX:INTEGER;

  BEGIN
       SEND[0]:=HOME; (home the cursor, SOROC requires nulls )
       SEND[1]:=NULL;SEND[2]:=NULL;
       UNITWRITE(2,SEND,3);
            FOR INDEX:=0 TO Y DO
                      SEND[INDEX]:=ACROSS;
            UNITWRITE(2,SEND,Y);
            FOR INDEX:=0 TO X DO
                      SEND[INDEX]:=DOWN;
            UNITWRITE(2,SEND,X);
 END.
```

Listing 2: *Pascal routine to place cursor at specified address on SOROC 120.*

```
This gotoxy procedure works with the SOROC 120 terminal.
PROCEDURE FGOTOXY(X,Y:INTEGER);
 CONST          ESCAPE=27;
  BEGIN
    WRITE(CHR(ESCAPE),'=',Y+32,X+32,CHR(0),CHR(0))
  END;
```

Answers to MicroShakespeare Quiz:

1 - b	6 - k	11 - f	16 - a
2 - r	7 - i	12 - g	17 - n
3 - l	8 - d	13 - m	18 - o
4 - c	9 - s	14 - j	19 - e
5 - q	10 - p	15 - h	20 - t

Who Should Attend

Designers, systems analysts, implementers, and managers with an interest in holding down costs on their software projects. Fields with special applicability include electronics and electronics design, automated manufacturing, scientific instrumentation design, and aerospace control systems.

Circle 66 on inquiry card.

Tentative Schedule

June 16, 1980

8:00- 9:00 A.M.	**REGISTRATION**
9:00-10:00 A.M.	**INTRODUCTION:** Carl Helmers
10:00-10:30 A.M.	**COFFEE INTERMISSION**
10:30-12:00 P.M.	**THE IMPORTANCE OF TOOLS:** Fred Martin
12:00- 1:30 P.M.	**LUNCHEON**
1:30- 3:00 P.M.	**THE PASCAL PERSPECTIVE:** Peter Grogono
3:00- 3:15 P.M.	**COFFEE INTERMISSION**
3:15- 4:45 P.M.	**AFTER PASCAL, WHAT?:** Ken Bowles
4:45- 5:15 P.M.	**OPEN DISCUSSION**

June 17, 1980

8:30-10:00 A.M.	**TREES AND LISTS AS TOOLS:** Henry Baker
10:00-10:30 A.M.	**COFFEE INTERMISSION**
10:30-12:00 P.M.	**THE FORTH ALTERNATIVE:** Charles Moore
12:00- 1:30 P.M.	**LUNCHEON**
1:30- 3:00 P.M.	**WHAT IS C?:** John Morse
3:00- 4:00 P.M.	**PANEL DISCUSSION:** All speakers

To attend the Languages and Tools for Microcomputing Conference, June 16-17, 1980, McGraw-Hill World Headquarters in New York City, fill in the coupon, or write on your company letterhead to:

McGraw-Hill Conference & Exposition Center
1221 Avenue of the Americas
Room 3677
New York, New York 10020
Or call: 212/997-4930

Registration Fee: $485

☐ Payment enclosed (Make check payable to McGraw-Hill Conference & Exposition Center)
☐ Please bill me directly
☐ Please bill company (Payment due prior to Conference)
☐ This confirms my phone reservation

Please Print or Type

NAME ____ Last Name ____ First Name
TITLE ____
COMPANY ____
ADDRESS ____
CITY ____ STATE ____ ZIP ____
TELEPHONE ( ) ____
REGISTRANT'S SIGNATURE ____

Z

Hotel Reservations: The New York Hilton (212-586-7000) is holding a block of rooms up to three weeks prior to the Conference. For reservations, contact the hotel directly. Please be sure to identify the title and dates of the Conference for preferential treatment.

Cancellation Liability: In the event of cancellation of the Conference for any reason, McGraw-Hill's liability is limited to the return of the registration fee.

Cancellation Policy: Confirmed registrants who cancel within FOURTEEN BUSINESS DAYS of the Conference are subject to a $100 service charge. Cancellation must be received in writing. Confirmed registrants who fail to attend and do not cancel prior to the Conference are liable for the entire registration fee. You may, if you wish, send a substitute.

Circle 66 on inquiry card.

BYTE News . . . .

NEW DEVELOPMENTS FROM COMMODORE: At a recent private showing during the Winter Consumer Electronics Show in Las Vegas, Nevada, Commodore Business Machines revealed some impressive work in progress. Heading the list was the prototype of the TOI ("The Other Intellect") color computer. Aimed at the low-end market, the TOI is designed to interface with your home color television set. The displayed image will feature 16 colors, 160 by 192 resolution (with three colors in the high-resolution mode), Microsoft BASIC, and a standard keyboard. The price could be under $700. Other devices included the Commodore CBM computer outfitted with a Shugart SA-200 5¼-inch floppy-disk drive (still under development). The SA-200 is a very low-cost drive that is less than 1 inch high, and employs an electromechanical track-to-track seeking mechanism for the head that is somewhat slower than conventional drive mechanisms. Commodore is also working on a Plato-like touch panel and a speech synthesizer (from Votrax). Also on hand was a prototype Memorex model 101 8-inch hard-disk drive and interface. Commodore stressed that all of these products were still under development, and that not all of them would necessarily get to the marketplace.

ATARI AND NAB TAKE FCC TO COURT: Atari Inc and the National Association of Broadcasters (NAB) have gone to the United States Court of Appeals asking that the Federal Communications Commission (FCC) review its recent decision allowing Texas Instruments Incorporated (TI) to sell its TI-900 stand-alone radio frequency (RF) modulator, which will allow a TI home computer to work with a standard color television set.

Late last year the FCC altered its rules (see BYTE News, January 1980) and granted TI a waiver. Atari asked the FCC to delay the effective date of the waiver until appropriate technical standards were developed. The FCC rejected Atari's request. Tandy Corporation and Apple Computer Company made similar requests. The requests claimed that the FCC decision allowed TI to circumvent the FCC's rulemaking.

The NAB is concerned with the interference that modulators cause on television and radio reception. The NAB is also challenging the FCC's radiation limits as being too high. This could cause interference, particularly in weak television signal areas. In addition to interference caused by personal computers, the NAB is concerned with interference from computer games and video recorders.

NEW HIGH-SPEED COMMUNICATIONS BUS: Xerox Corporation recently made a public announcement of a new concept of processor-to-processor communications intended for an office environment. This novel concept is called "Ethernet," and is a result of some of the work being done in their research labs. In this concept, a single coaxial cable is used as a high-speed communications bus between all processors; communication protocol is handled through software or software supplemented by special-purpose hardware. Rumor has it that an Ethernet processor is now being developed by some form of joint arrangement between Xerox and Intel.

NEW 16-BIT PROCESSOR CARDS TO BE INTRODUCED: Several manufacturers will soon introduce Z8000 and 68000 printed circuit cards for S-100 and SS-50 bus systems. Ithaca Intersystems Incorporated will shortly commence shipping its Z8000 processor card for S-100-based systems. They also have a 68000 prototype processor card running on the S-100 bus, but they do not plan to manufacture the card at this time. Gimix Incorporated does plan to manufacture a 68000 processor card for SS-50 bus systems. Gimix plans to use a multiplexed approach so that no reworking of the SS-50 mainframe will be required.

CAN DEPARTMENT STORES SELL PERSONAL COMPUTERS? The answer to this question from the stores, at this point, is a noncommittal "yes." Sears Roebuck and Montgomery Ward (MW) started test marketing personal computer systems last November. MW attempted selling several Ohio Scientific and Interact Electronics systems in a few selected stores. Although at the time of this writing not all results were in, the opinion was that the test, although not meeting with an enthusiastic response, developed sufficient sales to merit continued test marketing. Most system sales were to small businesses rather than consumers. The systems were being used for applications such as inventory control, word processing, and record keeping.

Sears Roebuck also was guarded in its appraisal of the test marketing of the Atari system through its Christmas catalog and selected stores. Although sales have not increased dramatically, they are sufficient for Sears to continue marketing tests.

IBM INDICATES NEW TECHNOLOGY COMING: New computer technologies from IBM will be used in computer systems available at the end of this decade. These systems will employ superconducting quantum interference devices (SQUIDs) using high-speed (0.06 nanosecond) Josephson-junction logic with 0.5 nanosecond programmable memory with up to 1000 connections between chip and carrier.

IBM also plans super-density logic cards (0.6 by 1.2 inch) with more than 300 "micro-pins" per card and up to 2500 printed wiring channels per inch. This will mean up to 10 times the density and 100 times the performance of the new IBM 4300-series systems. IBM will be able to build a processor with an internal performance of 70 million instructions per second (MIPS), 32 K byte cache memory, and 16 megabyte main memory in a 6-inch cube. Josephson-junction logic requires immersion in a liquid helium bath for proper operation.

RADIO SHACK SALES OVER $100 M FOR 79: Radio Shack's computer equipment sales were over $100 million for last year, according to Tandy. Furthermore, almost 150,000 TRS-80s have been sold. Industry experts estimate that Radio Shack has about 35% of the personal computer market. Sales of the TRS-80 appear to be leveling off; Radio Shack attributes this to market saturation. Radio Shack started shipping TRS-80 Model II systems to users in October, and by year's end had shipped about 1000 systems. Radio Shack chief Lewis Kornfeld anticipates selling 15,000 of these systems in 1980. Radio Shack plans to introduce a color-display replacement for the TRS-80 in the coming year, hoping to rejuvenate the sales curve—but normal production delays may affect the timetable.

S-100 MAGAZINE APPEARS: A magazine specifically oriented to S-100 systems users has begun publication. It features articles on S-100 hardware, CP/M (trademark of Digital Research), and Pascal software. A sample copy is $2 and can be obtained by writing *S-100 Microsystems*, POB 1192, Mountainside NJ 07082.

MICROPROCESSOR INVENTOR HONORED: Dr Marcian E Hoff has received recognition for the development of the microprocessor. Dr Hoff, of Intel Corporation, received the Stuart Ballantine Medal as an electronics pioneer. Shortly after joining Intel in 1969, he first proposed the microprocessor architecture which led to the development of the 4004, first produced in 1971. Dr Hoff also worked on the 1103, the first high-density programmable memory integrated circuit (1024 bits), and then Dr Hoff worked on analog-to-digital and digital-to-analog integrated circuits at Intel.

"ROBOTS" DO SALES PROMOTION: A new industry has developed in this country: using "robots" for sales promotion. These robots, which look very much like R2-D2 of *Star Wars*, are being used at public events promoting products like Coca-Cola, bank openings, and even the US Olympics organization.

One such maker is Promotional Concepts Incorporated of Atlanta, Georgia. This year they expect to make about 300 "robots," which they prefer to call "androids." Most will be 4 feet tall, weigh 90 pounds, and will be decorated to appear as Coke cans with arms, legs, and a dome. They move on three legs, talk, sing, whistle, rotate their domes, and move around. Power comes from an automobile battery, while voice and motion are controlled by a human operator via remote radio control and wireless microphone. The robots also have an internal tape player to supply music, beeps, and sounds. You can buy an "android" for $6500, or it can be rented for specific events.

COMPUTER FLEA MARKET COVERS 5 ACRES: The largest and oldest computer equipment flea market will be held this year on April 19 and 20 as a part of the Trenton Computer Festival (TCF) at Trenton State College, Trenton, New Jersey. The fifth annual flea market is jointly sponsored by three computer clubs—Amateur Computer Group of New Jersey, the Philadelphia Area Computer Society, and the Trenton State Computer Club. Hobbyists come from all across the northeastern USA to attend the event, where bargains on surplus gear are in abundance. Both flea market spots and admission are $5. There are also indoor commercial exhibitors, forums, talks, seminars, and user-group meetings. For information call (609) 771-2478 or write TCF, Trenton State College, Trenton NJ 08625.

NASA SHOPPING FOR A SUPERCOMPUTER: The National Aeronautics and Space Administration (NASA) is looking for a supercomputer—a numerical aerodynamic simulator—to perform wind-tunnel simulation. They have set a minimum sustained-performance level of one billion floating-point operations per second, or one "gigaflop." This is 30 to 40 times greater than the performance of machines such as the Cray-1 and Control Data Corporation's Cyber 203, which are presently considered the most powerful computers in production.

64 K EPROMS AVAILABLE BY MID-YEAR: 64 K EPROMs (erasable programmable read-only memory), organized as 8 K by 8 bytes, are currently being sampled by Motorola customers. Production quantities are expected to be shipped by the end of June. Motorola has put the 64 K EPROM in a 24-pin package by multiplexing the program supply and chip-enable signals on the same pin. Intel and Texas Instruments are believed to be using 28-pin packages for their 64 K EPROMs.

Meanwhile the supply of 2708 EPROMs (1 K by 8 bits) has caught up to demand and prices are now in the $6 range. The demand for 2716 EPROMs (2 K by 8 bits) is still very strong, and hence the devices are selling in the $20 to $24 range.

TI is currently the largest manufacturer of EPROMs with about 38% of sales. Intel is second with 29%, Fujitsu and Hitachi share third place with 8% each.

RANDOM RUMORS: At least one printer manufacturer will soon introduce a high-density, dot-matrix printer similar to the Sanders Technology Media 12/7 printer (see BYTE News, February 1979). It will sell for less than $2000 in original equipment manufacturer's (OEM) quantities and it will include a sheet feeder. Furthermore, they are promising a printing speed of 400 characters per second (cps) in a single-dot-density mode and 150 cps in a word processing mode. Like the Sanders Technology printer, the word processing mode will use overlapping dots to produce fully formed characters. . . .It is rumored that Intel will start sampling a 16 K static programmable memory in the third or fourth quarter of this year. . . .Sinclair Radionics, of Great Britain, may soon start sampling its flat cathode-ray tubes (CRTs). The Sinclair CRT has an electron gun that is parallel to the screen. . . .Disk drive designers are starting to talk about the 20 megabyte floppy disk and 200 megabyte 8-inch Winchester disk. These units are in the product planning stages now at a number of manufacturers. . . .Rumor has it that Burroughs is about to introduce a 5 megabyte 8-inch floppy-disk drive.

RANDOM NEWS BITS: Shugart Associates' SA450 5¼-inch Minifloppy™ with 500 K byte capacity may finally get into full production by late summer. Shugart experienced problems with its previous head designs which had a high incidence of media scoring. Shugart will use a new head design developed by and licensed from Tandon Magnetics Corporation. The design employs a fixed "button" head on one side of the disk and a gimballed head on a swing arm on the other side. The original Shugart design used two gimballed heads. Shugart hopes to be producing at least 2000 drives per month by late summer. . . .Dataland of Denmark has introduced a computer system to convert a composer's music into a printed score. A special piano keyboard is used to "play in" the voices in the score. The computer processes the input, and sends output to a digital plotter that creates the finished score ready for printing. . . .Intel is now producing 8 MHz 8086 16-bit microprocessors. The previous top speed was 5 MHz. . . .The Department of Defense (DOD) predicts that software-preparation costs will increase from the present $40 per line to $65 per line by 1984. Thus software preparation will be 8% of the total US defense budget—rising from $6.6 billion in 1979 to $10.5 billion in 1984. . . .Texas Instruments has introduced an alphanumeric display-driver integrated circuit (AC5947) that accepts ASCII character input and drives an 18-segment display . . . . Motorola has introduced opto-isolators with 7.5 kV isolation ratings . . . . Castle Toy Company is selling a "Superstar Guitar" with a built-in microprocessor. . . .William A Davis, Castro Valley, California, has announced a navigational computer that calculates longitude and latitude positions even if the navigator has no idea where he is. It also can calculate distances between any two points on earth and gives true bearing between them. It is accurate to 1/10th of a nautical mile.

MAIL: I receive a large number of letters each month, as result of this column. If you write to me and wish a response, please enclose a self-addressed, stamped envelope.

Sol Libes
Amateur Computer Group of New Jersey
(ACG-NJ)
1776 Raritan Rd
Scotch Plains NJ 07076

Calculating Filter Capacitor Values for Computer Power Supplies

John Thomas
c/o Hewlett-Packard
3070 Directors Row
Memphis TN 38131

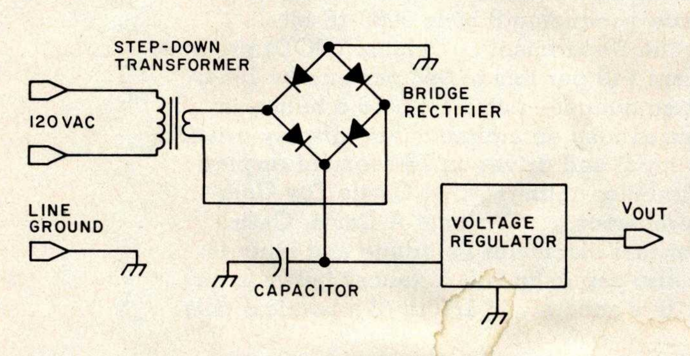


Figure 1: *Schematic diagram of a typical power supply circuit containing a step-down transformer, a full-wave bridge rectifier, a filter capacitor, and an integrated circuit voltage regulator.*

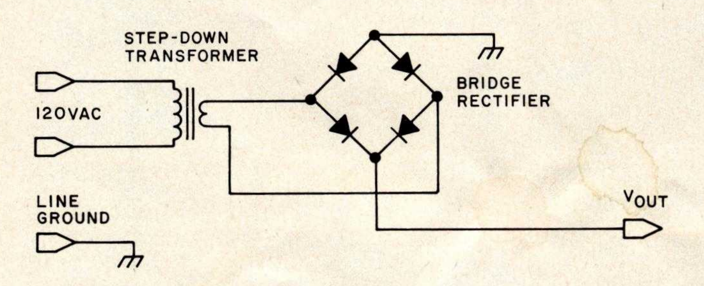


Figure 2: *Schematic diagram of the power supply without capacitor or regulator. This circuit produces the output voltage waveform shown in figure 3.*

Typically there are four functional elements in a homebrew computer power supply. These elements are: the transformer, full-wave bridge rectifier, filter capacitor, and one or more integrated circuit voltage regulators as shown in figure 1. Experience has shown that most homebrewers have little difficulty in choosing any of the components, except when it comes to finding the value of the filter capacitor. Then they must resort to methods of multiple approximation, charts and graphs, or the better known and widely used method of trial and error. The following information will simplify the process of finding the smallest value of capacitance that will work in the circuit.

Equation 1 gives the formula used to calculate the capacitor value:

$$C_{min} = \frac{i_{max}\left[\frac{1}{4f} + \frac{1}{2\pi f}\arcsin\left(\frac{V_{min}}{V_{max}}\right)\right]}{V_{max} - V_{min}} \qquad (1)$$

where:
f = the power-line frequency in hertz
V_{max} = the value of the peak positive voltage applied to the capacitor under the worst conditions (eg: highest operating temperature, greatest current, lowest power-line voltage)
V_{min} = the absolute minimum voltage allowable at the input of the voltage regulator

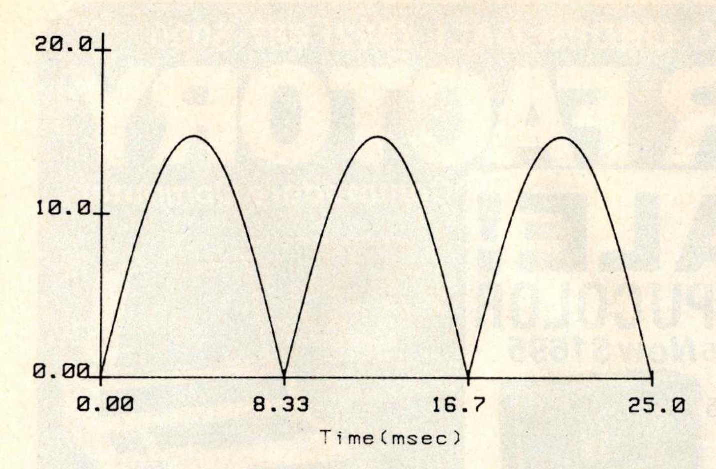


Figure 3: *The voltage waveform produced by the circuit of figure 2. The output of the rectifier stage of the supply is a pulsating current with only positive polarity.*

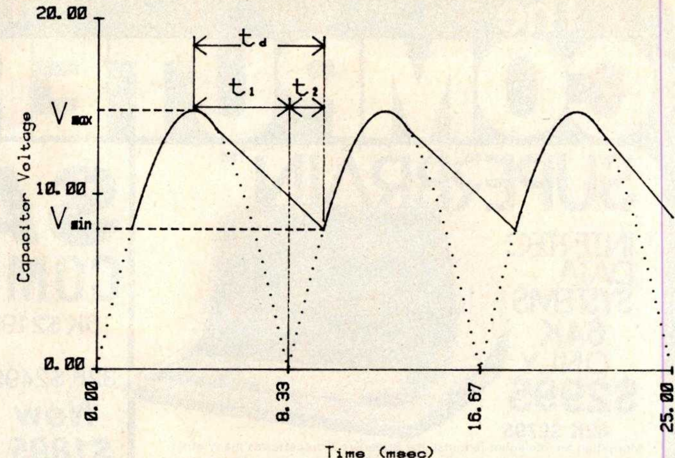


Figure 4: *Addition of a capacitor to the circuit has this effect on the output waveform. The capacitor smooths the humps in the waveform; an almost constant DC voltage with a small fluctuation (ripple) is presented to the voltage regulator stage of the power supply.*

Figures 3 and 4 were produced on a Hewlett-Packard 9872A plotter controlled by a Hewlett-Packard 9845A desk-top computer.

i_{max} = the maximum average current drawn during any one-quarter segment of a power-line cycle

C_{min} = the capacitance in farads; this is the minimum value that will meet the V_{min} specification

Those who are familiar with the above symbols and the effects of the circuit elements on the corresponding component values need read no further. However, anyone wishing to have a better description of V_{max}, V_{min}, i_{max}, and how to choose appropriate values, should read on.

Where the Formula Comes From

If the capacitor and voltage regulator are removed from the power supply in figure 1, the circuit of figure 2 remains. The circuit has an output-voltage waveform resembling that shown in figure 3. The waveform produced emulates the absolute value function of a sine curve. With the capacitor and regulator replaced so that the circuit is once again as shown in figure 1, the voltage across the capacitor will appear as shown in figure 4. Thus the capacitor has a smoothing-out effect on the waveform in figure 3. As shown in figure 4, the voltage across the capacitor follows the waveform of figure 3 while charging. When discharging, the voltage falls down to a value V_{min}. This value is the lowest voltage permissible as input into the voltage regulator, such that the regulator can still function properly. V_{min} should typically be about 2 V greater than the regulator-ouput voltage.

The capacitor formula is derived using the definition of capacitance found in almost any book on network theory:

$$i = C\frac{dv(t)}{dt} \qquad (2)$$

where:
i = current in amperes
v = voltage in volts
t = time in seconds

and:
C = capacitance in farads

This equation may be simplified by assuming that the current, i, is constant. This assumed value of current is the sum of currents drawn by the computer and the voltage regulator. If the current is not constant, it must be equal to the maximum *average* current drawn during any one-quarter segment of a power-line cycle. Once the current i is chosen and assumed constant, equation 2 can be simplified to give equation 3:

$$C = \frac{i_{max}\, t_d}{V_r} \qquad (3)$$

where:
i_{max} = the maximum average current discharging the capacitor during any one-quarter segment of a power-line cycle,
t_d = the capacitor discharge time (see figure 4), and
V_r = the ripple voltage, $V_{max} - V_{min}$

The time t_d over which the capacitor discharges can be broken into two parts, t_1 and t_2, as shown in figure 4. The time t_1 is the interval in which the sine waveform is decreasing, and is equal to one-fourth of the power-line frequency period. The time t_2 is the time required for the sine wave to go from 0 to V_{min}. For a power-line frequency of f, the total capacitor discharge time, t_d, is given by equation 4:

$$t_d = t_1 + t_2$$

$$t_1 = \frac{1}{4f}$$

$$t_2 = \frac{1}{2\pi f}\arcsin\left(\frac{V_{min}}{V_{max}}\right)$$



By Netronics

ASCII/BAUDOT, STAND ALONE

Computer Terminal

COMPLETE FOR ONLY... $149.95

The Netronics ASCII/BAUDOT Computer Terminal Kit is a microprocessor-controlled, stand alone keyboard/terminal requring no computer memory or software. It allows the use of either a 64 or 32 character by 16 line professional display format with selectable baud rate, RS232-C or 20 ma. output, full cursor control and 75 ohm composite video output.

The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock jumper, a drive capability of one TTY load, and the ability to mate directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

The Computer Terminal requires no I/O mapping and includes 1k of memory, character generator, 2 key rollover, processor controlled cursor control, parallel ASCII/BAUDOT to serial conversion and serial to video processing—fully crystal controlled for superb accuracy. PC boards are the highest quality glass epoxy for the ultimate in reliability and long life.

VIDEO DISPLAY SPECIFICATIONS

The heart of the Netronics Computer Terminal is the microprocessor-controlled Netronics Video Display Board (VID) which allows the terminal to utilize either a parallel ASCII or BAUDOT signal source. The VID converts the parallel data to serial data which is then formatted to either RS232-C or 20 ma. current loop output, which can be connected to the serial I/O on your computer or other interface, i.e., Modem.

When connected to a computer, the computer must echo the character received. This data is received by the VID which processes the information, converting to data to video suitable to be displayed on a TV set (using an RF modulator) or on a video monitor. The VID generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to which character and where it is to be displayed on the screen.

Video Output: *1.5 P/P into 75 ohm (EIA RS-170)* • **Baud Rate:** *110 and 300 ASCII* • **Outputs:** *RS232-C or 20 ma. current loop* • **ASCII Character Set:** *128 printable characters—*

!"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~

BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z - ? : * 3 $ # ( ) . , 9 0 1 4 ! 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return. Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE 800-243-7428

To Order From Connecticut Or For Technical Assistance, Etc. **Call (203) 354-9375**

Netronics R&D Ltd., Dept. PE-9
333 Litchfield Road, New Milford, CT 06776

Please send the items checked below—

☐ **Netronics Stand Alone ASCII Keyboard/Computer Terminal Kit, $149.95** plus $3.00 postage & handling.
☐ **Deluxe Steel Cabinet** for Netronics Keyboard/Terminal In Blue/Black Finish, **$19.95** plus $2.50 postage and handling.
☐ **Video Display Board Kit** alone (less keyboard), **$89.95** plus $3 postage & handling.
☐ **12" Video Monitor** (10 MHz bandwidth) fully assembled and tested, **$139.95** plus $5 postage and handling.
☐ **RF Modulator Kit** (to use your TV set for a monitor), **$8.95** postpaid.
☐ **5 amp Power Supply Kit** In Deluxe Steel Cabinet (±8VDC @ 5 amps, plus 6-8 VAC), **$39.95** plus $2 postage & handling.

Total Enclosed (Conn. res. add sales tax) $ ________
By—
☐ Personal Check ☐ Cashiers Check/Money Order
☐ Visa ☐ Master Charge (Bank # _ _ _ _)
Acct. # ________
Signature ________ Exp. Date ________
Print Name ________
Address ________
City ________
State ________ Zip ________
☐ Send Me More Information

Start Computing For Just $129.95 With An 8085-Based Professional Computer Kit—

Explorer/85

100% compatible with all 8080A and 8085 software & development tools!

No matter what your future computing plans may be, Level "A"—at $129.95—is your starting point.

Starting at just $129.95 for a Level "A" operating system, you can now build the exact computer you want. Explorer/85 can be your beginner's system, OEM controller, or IBM-formatted 8" disk small business system...yet you're never forced to spend a penny for a component or feature you don't want and you can expand in small, affordable steps!

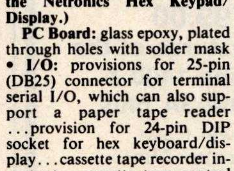
Now, for just $129.95, you can own the first level of a fully expandable computer with professional capabilities—a computer which features the advanced Intel 8085 cpu, *thereby giving you immediate access to all software and development tools that exist for both the 8085 and its 8080A predecessor (they are 100% software compatible)*—a computer which features onboard S-100 bus expansion—plus instant conversion to mass storage disk memory with either 5-1/4" diskettes or standard IBM-formatted 8" disks.

For just $129.95 (plus the cost of a power supply, keyboard/terminal and RF modulator, if you don't have them already), Explorer/85 lets you begin *computing* on a significant level... *applying* the principles discussed in leading computer magazines... *developing* "state of the art" computer solutions for both the industrial and leisure environment.

Level "A" Specifications

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, *plus* generous prototyping space.

(Level "A" makes a perfect OEM controller for industrial applications and is available in a special Hex Version which can be programmed using the Netronics Hex Keypad/Display.)

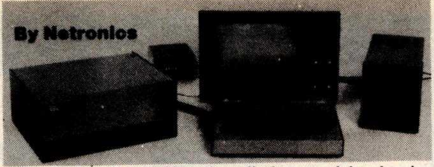


Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

PC Board: glass epoxy, plated through holes with solder mask • **I/O:** provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ...provision for 24-pin DIP socket for hex keyboard/display...cassette tape recorder input...cassette tape recorder output...cassette tape control output...speaker output... LED output indicator on SOD (serial output) line...printer interface (less drivers)...total of four 8-bit plus one 6-bit I/O ports • **Crystal Frequency:** 6.144 MHz • **Control Switches:** reset and user (RST 7.5) interrupt...additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard • **Counter/Timer:** programmable, 14-bit binary • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems...RAM expandable to 64k via S-100 bus or 4K on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F000 leaving 0000 free for user RAM/ROM. Features include tape load with labeling...tape dump with labeling...examine/change contents of memory ...insert data...warm start...examine and change all registers...single step with register display at each break point, a debugging/training feature...go to execution address... move blocks of memory from one location to another...fill blocks of memory with a constant...display blocks of memory ...automatic baud rate selection...variable display line length control (1-255 characters/line)...channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling...examine/change contents of memory...insert data...warm start...examine and change all registers...single step with register display at each break point ...go to execution address. Level "A" in the *Hex Version* makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.



By Netronics



Hex Keypad/Display.

Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys. 6 digit calculator type display which displays full address plus data as well as register and status information.

Level "B" Specifications

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks...address decoding for onboard 8k EPROM expansion selectable in 8k blocks...address and data bus drivers for onboard expansion...wait state generator (jumper selectable), to allow the use of slower memories...two separate 5 volt regulators.

Level "C" Specifications

Explorer/85 with L el "C" card cage.

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors.

Level "D" Specifications

Level "D" provides 4k or RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to EFFF in 4k blocks.

Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

Order A Coordinated Explorer/85 Applications Pak!

Experimenter's Pak (SAVE $12.50)—Buy Level "A" and Hex Keypad/Display for **$199.90** and get FREE Intel 8085 user's manual plus FREE postage & handling!

Student Pak (SAVE $24.45)—Buy Level "A," ASCII Keyboard/Computer Terminal, and Power Supply for **$319.85** and get FREE RF Modulator plus FREE Intel 8085 user's manual plus FREE postage & handling!

Engineering Pak (SAVE $41.00)—Buy Levels "A," "B," "C," "D," and "E" with Power Supply, ASCII Keyboard/Computer Terminal, and six S-100 Bus Connectors for **$514.75** and get 10 FREE computer grade cassette tapes plus FREE 8085 user's manual plus FREE postage & handling!

Business Pak (SAVE $89.95)—Buy Explorer/85 Levels "A," "B," and "C" (with cabinet), Power Supply, ASCII Keyboard/Computer Terminal (with cabinet), 16k RAM, 12" Video Monitor, North Star 5-1/4" Disk Drive (includes North Star BASIC) with power supply and cabinet, all for just **$1599.40** and get 10 FREE 5-1/4" minidiskettes ($49.95 value) plus FREE 8085 user's manual plus FREE postage & handling!

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE 800-243-7428

To Order From Connecticut Or For Technical Assistance, Etc. **Call (203) 354-9375**

Netronics R&D Ltd., Dept. RE 10
333 Litchfield Road, New Milford, CT 06676

Please send the items checked below—

☐ **Explorer/85 Level "A" Kit** (ASCII Version), **$129.95** plus $3 p&h.
☐ **Explorer/85 Level "A" Kit** (Hex Version), **$129.95** plus $3 p&h.
☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
☐ **8k Microsoft BASIC in ROM Kit** (requires Levels "B," "D," and "E"), **$99.95** plus $2 p&h.
☐ **Level "B" (S-100) Kit, $49.95** plus $2 p&h.
☐ **Level "C" (S-100 6-card expander) Kit, $39.95** plus $2 p&h.
☐ **Level "D" (4k RAM) Kit, $69.95** plus $2 p&h.
☐ **Level "E" (EPROM/ROM) Kit, $5.95** plus 50¢ p&h.
☐ **Deluxe Steel Cabinet** for Explorer/85, **$49.95** plus $3 p&h.
☐ **ASCII Keyboard/Computer Terminal Kit** (features a full 128 character set, upper & lower case, full cursor control, 75 ohm video output convertible to baudot output, selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator), **$149.95** plus $2.50 p&h.
☐ **Hex Keypad/Display Kit, $69.95** plus $2 p&h.
☐ **Deluxe Steel Cabinet** for ASCII Keyboard/Terminal, **$19.95** plus $2.50 p&h.
☐ **Power Supply Kit** (±8V @ 5 amps) in deluxe steel cabinet, **$39.95** plus $2 p&h.
☐ **Gold Plated S-100 Bus Connectors, $4.85** each, postpaid.
☐ **RF Modulator Kit** (allows you to use your TV set as a monitor), **$8.95** postpaid.
☐ **16k RAM Kit** (S-100 Board expands to 64k), **$199.95** plus $2 p&h.
☐ **32k RAM Kit, $329.95** plus $2 p&h.
☐ **48K RAM Kit, $459.95** plus $2 p&h.
☐ **64k RAM Kit, $589.95** plus $2 p&h.
☐ **16k RAM Expansion Kit** (to expand any of the above up to 64k), **$139.95** plus $2 p&h each.
☐ **Intel 8085 cpu User's Manual, $7.50** postpaid.
☐ **Special Computer Grade Cassette Tapes, $1.90** each or **3 for $5,** postpaid.
☐ **12" Video Monitor** (10 MHz bandwidth), **$139.95** plus $5 p&h.
☐ **North Star Double Density Floppy Disk Kit** (One Drive) for Explorer/85 (includes 3 drive S-100 controller, DOS, and extended BASIC with personalized disk operating system—just plug it in and you're up and running!), **$699.95** plus $5 p&h.
☐ **Power Supply Kit** for North Star Disk Drive, **$39.95** plus $2 p&h.
☐ **Deluxe Case** for North Star Disk Drive, **$39.95** plus $2 p&h.
☐ **Experimenter's Pak** (see above), **$199.90** postpaid.
☐ **Student Pak** (see above), **$319.85** postpaid.
☐ **Engineering Pak** (see above), **$514.75** postpaid.
☐ **Business Pak** (see above), **$1599.40** postpaid.

Total Enclosed $ ________
(Conn. res. add sales tax) By—
☐ Personal Check ☐ M.O./Cashier's Check ☐ Visa ☐ Master Charge
(Bank # _ _ _ _)
Acct. # ________
Signature ________ Exp. Date ________
Print Name ________
Address ________
City ________
State ________ Zip ________
☐ Send Me Information

or:

$$t_d = \frac{1}{4f} + \frac{1}{2\pi f}\arcsin\left(\frac{V_{min}}{V_{max}}\right) \qquad (4)$$

After substituting for t_d and V_r in equation 3, the final cookbook formula given in equation 1 is obtained.

Design Example

As an example, suppose that a microcomputer board requires a 5 V supply to deliver 3 A. Assume that V_{max} under the worst-case conditions is found to be 14.8 V and that the integrated circuit voltage regulator requirements set V_{min} to be 8.0 V. (The values for V_{max}, V_{min}, and i_{max} were taken from chapter 8, page 9 of the *Voltage Regulator Handbook* by National Semiconductor. The value calculated in the handbook was 2400 μF.)

$$C_{min} = \frac{3\ \text{A}\left[\frac{1}{4(60\ \text{Hz})} + \frac{1}{2\pi(60\ \text{Hz})}\arcsin\left(\frac{8.0\ \text{V}}{14.8\ \text{V}}\right)\right]}{14.8\ \text{V} - 8.0\ \text{V}}$$

therefore:

$$C_{min} = 2500\mu\text{F}$$

Some Dangers to Watch Out For

In all of the discussion so far, it has been assumed that the capacitor can tolerate any ripple voltage. This is simply not so. Ripple voltages cause the capacitor to heat up inside. If the ripple voltage is too high, the capacitor can become too hot and explode. The value of V_{max} may have to be decreased to meet capacitor ripple voltage requirements. Consult the manufacturer's specifications for the capacitor's maximum ripple voltages and/or currents. Also, carefully check the tolerances for the value of the capacitor.

Also, care must be taken not to choose too high a value of V_{max}. Transformer-winding resistance, diode-voltage drops, diode capacitance, and low power-line voltage are some of the factors that must be considered when choosing the value of V_{max}. Setting V_{max} too high will result in C_{min} being too small.

Conclusion

Use of the formula is a fast and accurate method of finding filter capacitor values. Careful choice of V_{max}, V_{min}, i_{max}, and quality components will produce a power supply which will provide good performance.■

The author wishes to thank Mr Scott Eanes of Hewlett-Packard for his assistance in producing the graphs for this article.

References

1. *Voltage Regulator Handbook* by National Semiconductor, 2900 Semiconductor Dr, Santa Clara CA 95051.
2. Millman and Halkias, *Integrated Electronics: Analog/Digital Circuits and Systems*, McGraw-Hill, 1972.
3. Hayt and Kemmerly, *Engineering Circuit Analysis*, McGraw-Hill, 1971.

Circle 69 on inquiry card.

A Graphics Text Editor for Music

Part 1: Structure of the Editor

Randolph Nelson
2039 W Artesia Blvd
Apt 121
Torrance CA 90504

This two-part article describes the design of a musical text editor which could be implemented on a home computer graphics system. It is intended to be an overview of the basic design (part 1), along with the essential algorithms (part 2). A complete description of the system would take too much space. The editor allows a user to input a score of music and make corrections or modifications to it. The program stores the score, alters it according to the commands of the user, and displays the music on a graphics screen. All formatting, staffing and arranging of the score on the screen is done automatically by the program. Using the editor requires no special skills or knowledge. Before discussing the editor, it might be helpful to review musical notation.

Musical Notation

Written music is one of the most complex languages that man has invented. Its notation rivals mathematics in the diversity of its symbols and the richness of its expression. I can only hope to provide those readers not familiar with reading music with an appreciation of the problems that must be solved by the editor in storing and displaying this complex language. During the following discussion the reader should consult the accompanying tables and figures.

A score of music consists of a sequence of pages much like a book. A page contains several staffs, each consisting of five parallel horizontal lines stacked on the page. These are called lines of music; at the beginning of each is a clef sign to signify the pitch values of each line of the staff, a key signature which denotes any of twelve major keys that the music can be written in, and a time signature consisting of two numerals, one placed on top of the other, much like a fraction. The upper numeral denotes the number of beats in each measure (to be presently defined) and the lower numeral denotes which note value is to be used as the value of one beat. The rest of the line consists of a sequence of measures separated by bar lines, which are vertical lines on the staff. The number of measures in each line depends only upon the demands of readability. Some measures occupy more space than others, but all of the bar lines at the end of each line are arranged to line up in the same manner as the right margins on a page of written text (a process called *right justification*). The contents of the measures consist of notes, rests, and other symbols.

Each note consists of an oval area which is either filled in with ink or left empty, and a stem, which is a straight line segment. Associated with each note is a pitch and a duration. The pitch is indicated by the clef and the note's vertical displacement on the staff — the higher up the staff, the higher the pitch. Notes that have a higher pitch than the top line of the staff would indicate are positioned on small lines (called ledger lines). The ledger lines are a temporary continuation of the main staff lines. One can thus think of the staff as being many parallel lines, of which only five are shown.

The time duration in which a given note is to sound is determined by the intrinsic relative value given to its symbol, the time signature of the particular piece of music, and the tempo indicated. To simplify the discussion here, assume that a quarter note has a

About the Author
Randolph Nelson has a background both in music and in computer science. He studied clarinet for 15 years, and wavered between the two fields before deciding to complete a master's degree in computer work. Now he is studying for a PhD in computer communication networks at UCLA.

BRAG, BRAG, BRAG, BRAG.

And why not? We have something to brag about! In less than eight months, more than five thousand people have proudly purchased Word Star™ from over 280 dealers around the world.

The reason is simple. Word Star™ is *the* word processing software package for Z-80, 8085 and 8080 microcomputers.

So go ahead. Call us at (415) 457-8990 for the name of your nearest dealer.

He's got a great deal to brag about, too.

WORD-STAR™ by MicroPro

We've got a lot to brag about.

MicroPro International Corporation
1299 4th Street, San Rafael, California 94901
Telex 340388 Dealer/Distributor/O.E.M. inquiries invited.

Stop by booth 16 at the NCC & Personal Computing Festival in Anaheim so we can brag, brag, brag.

value of one beat (ie: that the lower numeral in the time signature is 4), and relative beat values will be given according to this standard.

Often a small dot is placed after a note. This increases the time value of the note by half of its original value. Dot placement may be done recursively; two dots increase the value by ¾, three dots by ⅞, etc.

When notes with flags (eighth, sixteenth, and smaller values) occur adjacently, they are often grouped together by changing the flags into a roughly horizontal bar or bars, which connect the stems of the notes. These bars are properly called *beams*, or *ligatures*. Each beam represents one flag in determining the time value of the note.

Depending upon whether the note stems are pointing up or down, the beams may be located either above or below the notes. Descriptive terms that I use are as follows: a group of notes connected by a beam is a *beaming group*. Placing the beam above the note heads and stems is overbeaming. Placing the beam below the note heads and stems is underbeaming.

Additional symbols occurring in music are sharps, flats, double sharps, double flats, and natural signs. These may be placed together to indicate a *key signature*, or singly (as *accidentals*) to indicate modification of pitch for a single note. In the latter case, they are placed immediately to the left of the note head, the oval part of the note. (See table 2.)

Rests indicate durations during which no notes in a given part are played (ie: silence). They have a duration which is determined only by their shape, the time signature, and for some types, the number of flags they exhibit. Music abounds in special symbols that are used to indicate the amplitude (ie: volume) of the sound, changes in amplitude, the speed (ie: tempo) of the music, and rhythmic variations. The placement of these symbols often depends upon the context of the music, and for every rule regarding their location there are numerous exceptions.

We do not have space here to discuss all of the details of musical notation. An exhaustive description



Let this New Series from BYTE BOOKS™ answer your programming questions

Programming Techniques is a series of collected articles concerned with the art and science of computer programming. The first volume in the Programming Techniques series is entitled **Program Design.** The purpose of the book is to provide the personal computer user with the techniques needed to design efficient, effective, maintainable programs.
ISBN 0-07-037825-8 Pages: 96
Price: $6
Editor: Blaise W. Liffick

Simulation is the second volume in the Programming Techniques series. Both theoretical and practical applications are included. Particularly stressed is simulation of motion, including wave motion and flying objects, and the use of simulation for experimentation.
ISBN 0-07-037826-6 Pages: 126
Price: $6
Editor: Blaise W. Liffick

Numbers in Theory and Practice is the third book in the series. It includes information of value to both the novice and the experienced personal computer user. The mechanics of the binary system are discussed, including software division and multiplication, as well as floating point numbers, numerical methods, random numbers, and the mathematics of computer graphics.
ISBN 0-07-037827-4 Pages: 192
Price: $8.95
Editor: Blaise W. Liffick

The 4th volume of the Programming Techniques series, **Bits and Pieces,** covers various topics of interest to programmers. It is a collection of the best articles from past issues of BYTE magazine plus new material collected specifically for the series, on subjects such as multiprogramming, stacks, interrupts optimation, and real time processing.
ISBN 0-07-037828-2 Pages: 160
Price $8.95
Editor: Blaise W. Liffick

McGraw Hill

Please send
☐ ________ copies of **Program Design**
☐ ________ copies of **Simulation**
☐ ________ copies of **Numbers in Theory and Practice**
☐ ________ copies of **Bits and Pieces**

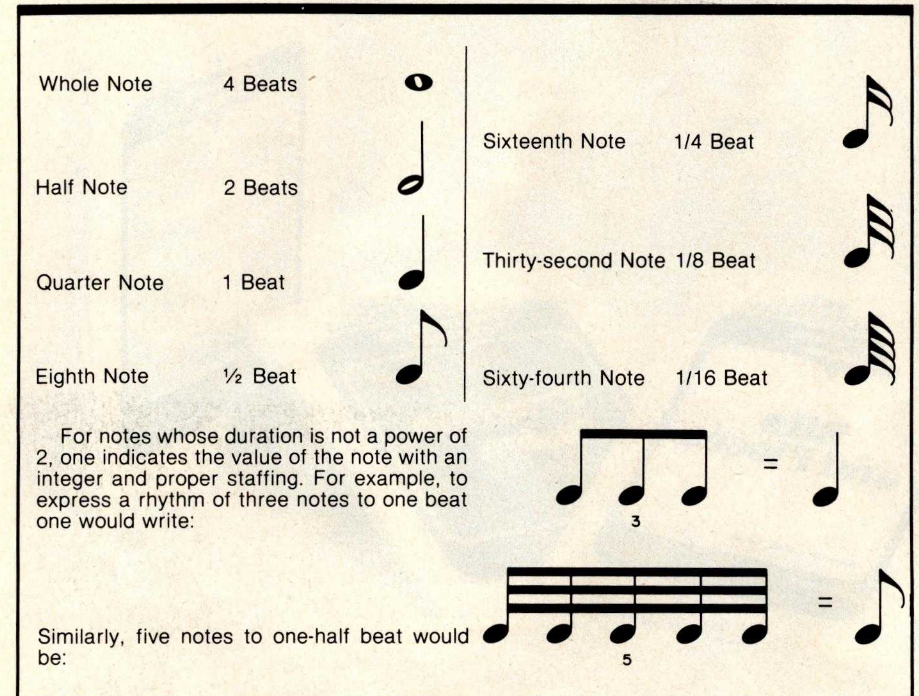
Name ________ Title ________ Company ________

Street ________ City ________ State/Province ________ Code ________

☐ **Check enclosed in the amount of $________**
☐ **Bill Visa** ☐ **Bill Master Charge**
Card No. ________ Exp. Date ________
Add 75¢ per book to cover postage and handling.

BYTE BOOKS
70 Main St, Peterborough, NH 03458

Circle 127 on inquiry card.



Whole Note	4 Beats	
Half Note	2 Beats	
Quarter Note	1 Beat	
Eighth Note	½ Beat	
Sixteenth Note	1/4 Beat	
Thirty-second Note	1/8 Beat	
Sixty-fourth Note	1/16 Beat	

For notes whose duration is not a power of 2, one indicates the value of the note with an integer and proper staffing. For example, to express a rhythm of three notes to one beat one would write:

Similarly, five notes to one-half beat would be:

Table 1: *The most common musical notes and their duration in beats, where a quarter note equals one beat.*



Figure 1: *Symbols used in musical notation, shown in their natural habitat, the staff. They are as follows:* **a**, *treble or G clef;* **b**, *key signature of two flats (showing key of B flat major or its relative minor key of G minor);* **c**, *time signature (indicating four beats to a measure with the quarter note receiving one beat);* **d**, *bar line;* **e**, *whole note on leger line below staff;* **f**, *whole note on leger lines above staff;* **g**, *bass or F clef;* **h**, *key signature of one sharp (indicating key of G major or E minor);* **i**, *whole note;* **j**, *half note;* **k**, *quarter note;* **l**, *eighth note (with flag);* **m**, *sixteenth note (with two flags);* **n**, *dotted half note (receives 150% of its normal time value);* **o**, *eighth notes (with beam and marked with dots under note head, indicating staccato);* **p**, *sixteenth notes (with double beam);* **q**, *half note with sharp accidental (raising its pitch one semitone) that has a fermata above it (indicating a longer time value with performer discretion);* **r**, *a dotted eighth note followed by a sixteenth note (indicated by a broken beam);* **s**, *a whole rest;* **t**, *a half rest;* **u**, *a quarter rest;* **v**, *an eighth rest;* **w**, *a sixteenth rest.*

may be found in the book *Music Notation: A Manual of Modern Practice* by Gardner Read. Figure 1 shows many of the more common symbols which are used in the editing system.

Basic Problems of the Editor

Now that we have an appreciation for the notation we are trying to computerize, let us approach the basic problems of the editor. There are four main problems to be solved:

- **Input** — How will the user translate the score into a computer readable form?
- **Data Structures** — After the score is entered, what structures will the program use to store the information?
- **Commands** — What commands should be provided for the user to allow ease in editing the score?
- **Output** — How will the internal encoding of the score be finally displayed on the graphics screen?

I will discuss each of these problems in detail and outline the solutions.

Input

All input to a computer consists of a linear sequence of integers. Our problem then consists of finding a way to convert a musical score into such a sequence. The nature of musical notation is two-dimensional, with a horizontal component and, since symbols can be stacked on top of each other, a vertical component. Converting this essentially planar notation into a linear notation is no easy task, and if the user is not to be burdened with a complicated input format, some way must be found to structure the input also to be two-dimensional, and to let an interface program convert the input into integers.

Fortunately there is a specialized hardware unit that allows us to do

Text continued on page 132

Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

New NRI Home Study Course Shows You How to Make Money Servicing, Repairing, and Programming Personal and Small Business Computers



Seems like every time you turn around, somebody comes along with a new computer for home or business use. And they're being gobbled up to handle things like payrolls, billing, inventory, and other jobs for businesses of every size...to perform household functions like budgeting, environmental systems control, indexing recipes, and more.

Growing Demand for Computer Technicians... Learn in Your Spare Time

Even before the microprocessor burst upon the scene, the U.S. Department of Labor forecast over a 100% increase in job openings for the decade through 1985. Most of them *new* jobs created by the expanding world of the computer. NRI can train you at home to service both microcomputers and their big brothers. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends without quitting your present job.

Assemble Your Own Microcomputer

NRI training includes practical experience. You start with meaningful experiments building and studying circuits on the NRI Discovery Lab® Then you build your own test instruments like a transistorized volt-ohm meter, CMOS digital frequency counter...equipment you learn on, use later in your work.

And you build your own microcomputer, the only one designed for learning. It looks and operates like the finest of its kind, actually does more than many commercial units. But NRI engineers have designed components and planned assembly so it demonstrates important principles, gives you working experience in detecting and correcting problems. It's the kind of "hands-on" training you need to repair and service units now on the market.



Mail Coupon for Free Catalog No Salesman Will Call

Send today for our 100-page, full-color catalog. It describes NRI's new Microcomputer Technology course in detail, shows all equipment, kits, and lesson plans. And it also tells about other NRI courses... Complete Communications with 2-meter transceiver...TV/Audio/Video Systems Servicing with training on the only designed-for-learning 25" diagonal color TV with state-of-the-art computer programming. With more than a million students since 1914, NRI knows how to give you the most in home training for new opportunity. If coupon has been removed, write to NRI Schools, 3939 Wisconsin Ave., Washington, D.C. 20016.

RUSH FOR FREE CATALOG



NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

Please check for one free catalog only.

NO SALESMAN WILL CALL

All career courses approved under GI Bill.
☐ Check for details.

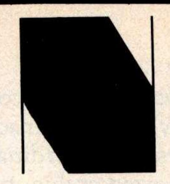
- ☐ Computer Electronics Including Microcomputers
- ☐ TV/Audio/Video Systems Servicing
- ☐ Complete Communications Electronics with CB • FCC Licenses • Aircraft, Mobile, Marine Electronics
- ☐ CB Specialists Course
- ☐ Amateur Radio • Basic and Advanced
- ☐ Digital Electronics • Electronic Technology • Basic Electronics
- ☐ Small Engine Repair
- ☐ Electrical Appliance Servicing
- ☐ Automotive Mechanics
- ☐ Auto Air Conditioning
- ☐ Air Conditioning, Refrigeration, & Heating Including Solar Technology

Name (Please Print) Age

Street

City/State/Zip

Accredited by the Accrediting Commission of the National Home Study Council 170-040



NEECO
PROUDLY
INTRODUCES

MULTI-CLUSTER

"Multi User Management System for Commodore CBM/PET Computers"*

UP TO 8 CBM/PETS MAY NOW SIMULTANEOUSLY ACCESS ONE 2040!



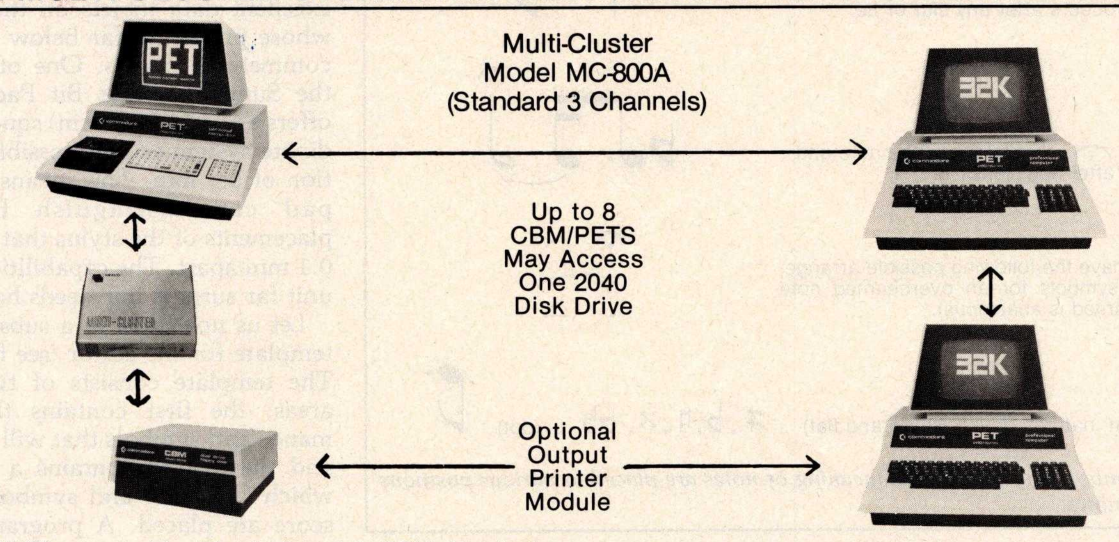
Channel Module
CM-800

Multi-Cluster
Model MC-800A
Standard 3 Channels)

$995

- Up to 8 Channel (3 Standard) for CBM/PET Computers.
- Up to 8 CBM/PETS can multi-use one Commodore 2040 dual disk drive simultaneously with equal access.
- Multi-Cluster supports all 2040 disk O/S commands including sequential, random access, and user files.
- Multi-Cluster does not utilize any RAM or ROM from the 2040 or host CBM/PET units.
- Multi-Cluster is compatible with all known softwear that utilize the IEEE port.
- Multi-Cluster can be fully implemented on 8 PETS, completely ready to use, in less than 15 minutes.
- Simply plug the Multi-Cluster unit into the IEEE port of the 2040 Disk Drive, then attach a Channel Module, #CM800, (3 Channel Modules are standard with unit), to the IEEE port of each PET.

THE MULTI-CLUSTER SYSTEM HAS BEEN USED AND FULLY-TESTED BY NEECO



Multi-Cluster is ideal for industrial, OEM, Vertical Markets, and Educational Institutions. Multi-Cluster allows you to make full use of the Commodore 3 units for the price of 2 educational programs.

Output Printer Module allows 1 CBM/PET to scan 2040 Disk and print flagged files.

Standard Components:

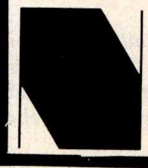
1 Multi-Cluster	#MC800A
3 Channel Modules	#CM-100
3 6′ Ribbon Cables	#RC6

Optional Component Prices:

Each additional CM-100	$250
Each 12′ Ribbon Cable (RC12)	$ 40
Each 18′ Ribbon Cable (RC18)	$ 60
Output Printer Module (PM200) (For Centronics Protocal Printers)	$200

*PET is a registered trademark of Commodore Business Machines. Small Keyboard PETS require a ROM Retrofit Kit for Multi-Cluster system operation.

Multi-Cluster is available in Canada from BMB Compu Science, Milton, Ontario, (416) 878-7277



NEECO
679 Highland Ave.
Needham, MA
02194

Dealer Sales:
Microamerica Distributing
21 Putnum St., Needham, MA 02194
(617) 449-4310 **Telex: 951021**

Customer Sales:
NEECO
679 Highland Ave., Needham, MA 02194
(617) 449-1760

Circle 74 for NEECO

Circle 264 for microamerica

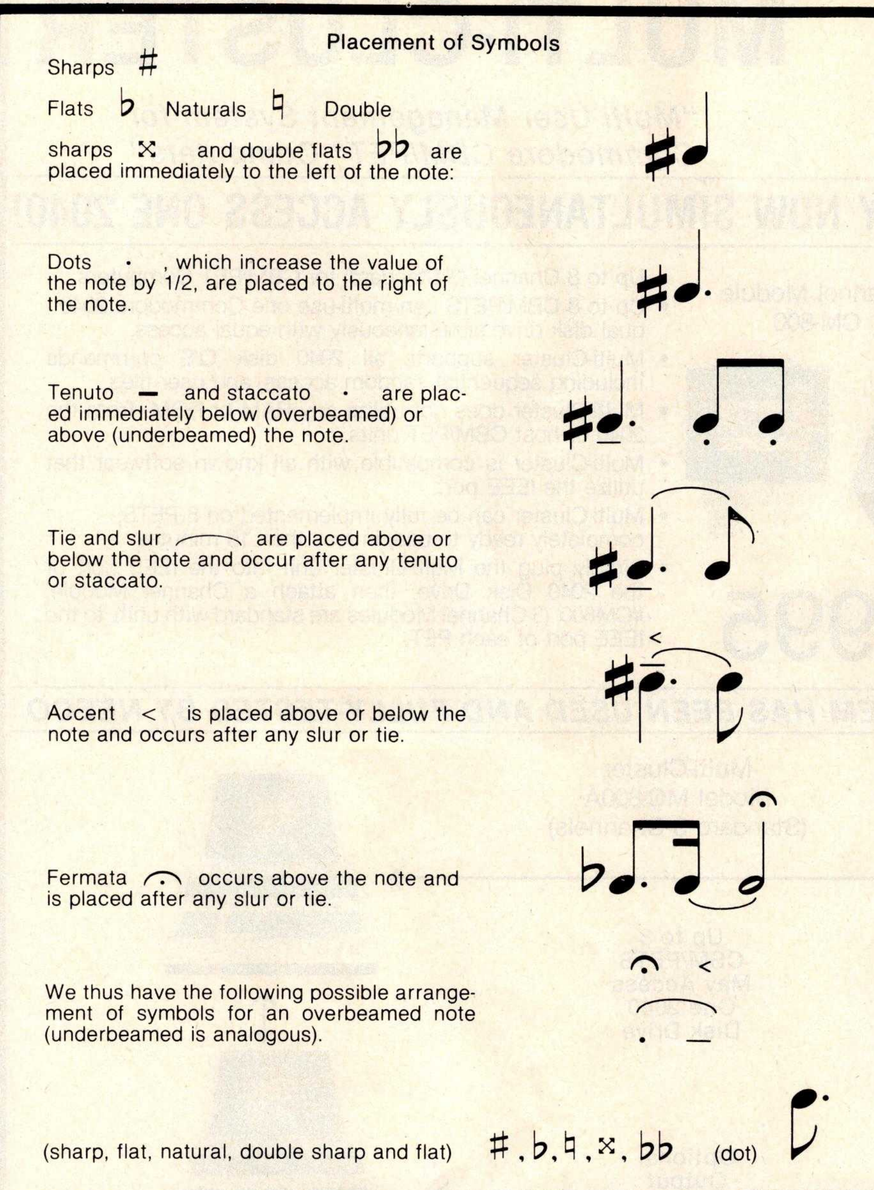


Table 2: *Symbols that modify the meaning of notes are placed in various positions around the notes.*

Text continued from page 128:

this, called a graphics tablet. It consists of a flat board which has sensors placed in a cartesian coordinate system. Using a pen-sized stylus, one of the coordinates from the tablet can be designated by placing the stylus on the board and pressing. A typical way to use the tablet is to prepare a template or menu that is placed over the board. This template is divided into regions, each region representing a different command. If a particular command, say to *edit*, occupies the area bounded by the X coordinate within 100 and 200, and the Y coordinate within 300 and 400, the placement of the pen at the point (150, 310) allows the interface program, with two conditional statements, to ascertain the command to *edit*.

Lest this special hardware unit dissuade the reader from continuing, I might add that there are a number of excellent data tablets on the market whose prices are far below previous commercial models. One of these is the Summagraphics Bit Pad, which offers an 11-inch (29 cm) square coordinate system with a possible resolution of 0.1 mm. This means that the pad can distinguish between placements of the stylus that are only 0.1 mm apart. The capabilities of this unit far surpass our needs here.

Let us now look at a subset of the template for the editor (see figure 2). The template consists of two main areas: the first contains the commands and symbols that will be used, and the second contains a staff on which the notes and symbols of the score are placed. A program which

TENUTO	♯	𝄐		p	ALLEGRO	VIVACE	FORWARD	BACKWARD	NULL EXIT
DOT	♭		CRESC	m	ANDANTE	LENTO	INSERT	DELETE	EXIT
REST	♮	<		f	MODERATE	LARGO	CREATE	DISPLAY	EDIT
NOTE	𝄪	♭♭	DIM	3/4	RETENEZ	CHARACTER	MEASURE	LINE	PAGE

Figure 2: *Musical template for the editor. The software music editor described in the article uses a data entry tablet with a pen for entering musical symbols. The top of the template contains the commands and symbols recognized by the editor, and the bottom is a musical staff on which the notes and symbols are placed. A program acting as the interface between the output of the tablet and the input to the editor reads the placement of the stylus, converts this into a set of commands, and sends them to the editor in the computer.*

acts as the interface between the output of the tablet and the input to the editor reads the placement of the stylus, converts this into an internal code, and encodes a set of commands that it will eventually send to the editor. This interface program also handles the sorting and placement of all symbols, thus alleviating the user from the left-right horizontal input of the score.

The following is the procedure for entering a typical musical score (see figure 3) into the computer:

1. Touch the stylus to the treble clef sign of the template. This tells the program that the measure being created starts with a clef.
2. Touch the appropriate position for key signature placement.
3. Touch the time signature command, as appropriate.
4. Touch the note symbol. This tells the interface that the input of notes now begins. Everywhere the pen is touched on the staff is a place for a note until a future command is activated.
5. Touch the staff in the correct places for the notes indicating both time (the horizontal distance using the notes on the template as a guide) and pitch (the vertical placement on the staff).
6. Touch the sharp sign and touch the note that is to receive it as an accidental.
7. Touch the f, mp, and mf signs, and touch the staff in the correct places.
8. Touch the crescendo sign and the first and last points that bound its range.
9. Touch the diminuendo sign and the first and last points that bound its range.
10. Touch the bar line at the end of the staff to indicate the end of a measure.

Whole rest	4 Beats
Half rest	2 Beats
Quarter rest	1 Beat
Eighth rest	1/2 Beat
Sixteenth rest	1/4 Beat
Thirty-second rest	1/8 Beat
Sixty-fourth rest	1/16 Beat

Table 3: *Rests and their values.*

Crescendo (getting louder)
Diminuendo (getting softer)
Soft *p* Loud *f* Medium *m* and all combinations ie: *mp*, medium soft
Numerous others and written text usually in italics.

Table 4: *Other symbols.*

The Data Structures

There are four main data areas in the editor, each with different formats and methods of access:

1. The score area. In this area is the computer version of the score, which is divided into four main sections: character, measure, line, and page information. Access can be made to any of these four sections.
2. The screen area. Data here consists of codes that allow the computer to easily display the score on the screen. Each of these codes causes the machine to draw or point to a different spot of the graphics screen or invoke a routine to draw a symbol. There is a mapping program that takes a measure in score-area format and converts it into screen-area format.
3. The work area. When a measure is being edited, it is brought into the work area from the score area and the screen area. All changes to the characters occur in the work area. There is a mapping from the screen (ie: where the user does the editing) to the work area, so that any changes made appear in both places. After editing, the new measure is put into a free location determined by the free storage routines, and the score and screen areas are adjusted accordingly.
4. The free area. These areas record the locations and lengths of free storage area in the score and screen areas. Storage routines access this area to determine the locations of the measures in each of the score and screen areas.

Whenever the user writes a program, the commitment to the actual form of the data should be postponed until the last moment. The methods



Figure 3: *Section of a typical musical score. The procedure for entering it into the computer by use of the graphics tablet is explained in the text.*

of access should be specified in detail before deciding on the actual structure of the information. Once the form is decided, the structures should be accessed only through routines that may be called from the procedures of the program. This design method is called *encapsulating the data*. Its use is essential if you anticipate modifications or changes to the way the information is stored.

The editor has a two-level encapsulation scheme. The first level consists of primitive data operations that manipulate the actual data of the score, screen, work, and free areas. References to the actual data can be made only through these primitive routines, and it is only for these routines that the actual form of the data is important. For example, the score area is divided into four types of data manipulation. Routines for character, measure, line, and page manipulation are provided. All of the primitive routines for manipulating characters of a measure are listed below:

GETFCH (Get forward character) This routine increments a pointer so that it points to the next character of the measure.

PUTFCH (Put forward character) This routine inserts information about a new character after the current pointer.

KILLCH (Kill character) This routine deletes the character presently pointed to. The pointer points to the next character.

GETPCH (Get previous character) This routine moves the pointer so that it points to the previous character. GETPCH is the opposite of GETFCH.

PUTPCH (Put previous character) This routine inserts a new character before the current pointer. PUTPCH is the opposite of PUTFCH.

These are the only routines which reference characters of the score area; all character manipulations must be done via these primitives. For example, if the user wishes to edit measure 5, the editor must first transfer the contents of measure 5 to the work area. The routine MOVMSR, which is in the second level of encapsulation, performs this task by making calls to the primitive routines GETFCH and PUTWRK. PUTWRK is a primitive routine for the work area that takes a character and inserts it after the current work pointer. MOVMSR, like all routines in the second level, consists of a sequence of calls to the primitive routines of the first level. It would appear something like:

1. IF at end of measure THEN exit
2. GETFCH
3. PUTWRK
4. GO TO 1

There are about 50 first-level primitive routines, most of which are only a few lines of code, and about 150 second-level routines in the editor. Any changes to the structure of the data (eg: changing the way the score is stored from a set of arrays to a tree) influences only a subset of the

50 primitive routines. Nothing has to be altered in the second-level routines nor in the procedures that call them. Thus, changing the form of the data is a relatively easy task. Each data structure area has its own primitive and second-level routines that perform all manipulations on them.

Let me now discuss the actual data structures which I chose to use. Since I was designing the project using the FORTRAN language, arrays were a natural choice. For clarity, the packed arrays are separated into single arrays containing one integer each.

The Score Area

The score area consists of four sets of arrays which are linked together as a doubly-linked list. This structure allows easy determination of the location of any measure in the score. I will discuss each of these arrays.

1. The Page Array

The page array contains a pointer (index) to the first line of that page. Figure 4 shows that the first page starts with line one (always the case) and the second page starts with the fifth line. Since the number of lines per page is determined when the user specifies the size of the staff, you might think that the array could be eliminated with a simple division. In the actual design, however, the page array also contains information used to determine if the page had been edited, and would thus need to be reformatted. It is included here for clarity.

2. The Line Array

Each line contains a pointer to the page that it belongs to and also to its first measure. Also contained is the scale factor for the line, which will be used when displaying the line on the screen. Later we will show the algorithm for calculating this factor and its use. Figure 4 shows that the fifth line belongs to the second page, that it starts with the fourteenth measure, and that it has a scale factor of 1.01.

3. The Measure Array

The measure array contains three pointers. One points back to the line array, one to the first character of the measure in the character array, and one to the first character that will be drawn on the screen in the screen array.

4. The Character Array

All of the information about the measure is contained in these arrays. The first two elements of these arrays are a pointer back to the measure array and the virtual length of the measure (later to be defined and calculated). The rest of the array contains codes and integers that identify the symbol, its X and Y location coordinates, and its duration (if it is a note or rest). Note that the ordering of the measures in the character array is not necessarily sequential. The example shows that the third measure, locations 35 thru 60, comes between the first, 1 thru 20, and the second, 101 thru 150. The reasons for this will be clear when the free area is discussed.

The doubly linked nature of the data allows you to easily answer questions concerning the location of pages, lines, and measures. For example, the page and line that contain measure 15 can be determined by tracing the pointers in measure 15 to line 5, and tracing the pointer in line 5 to page 2. It is clear that all such questions can be answered in this manner. I will show the use of this feature when I discuss the commands of the editor.

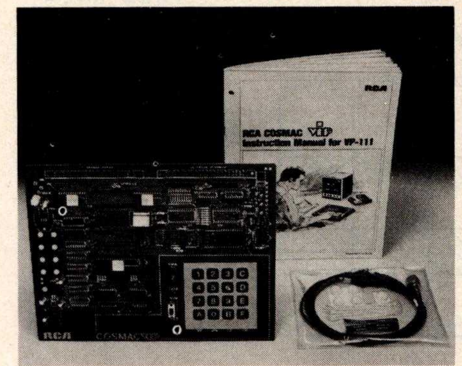
The Screen Area

The screen array contains information used when the score is displayed on the screen. Remember that the measure array contains a pointer to the screen area which identifies the screen locations containing the characters for that measure. Likewise the screen array contains a pointer to the measure array. The rest of the information in the screen array consists of the X and Y location of a symbol to be drawn on the screen, and a code which denotes the character to be drawn. The editor has a procedure that takes all of the information about one measure in the character array and translates it into the form required by the screen array. The screen array also has a nonsequential placement of measures like the character array.

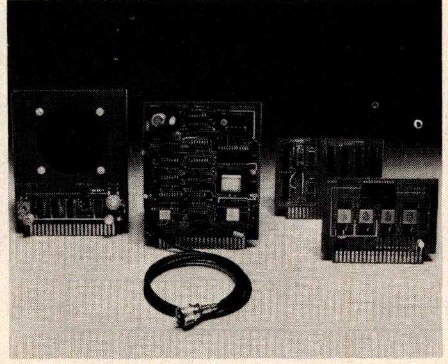
The Work Area

The work area contains two sets of

The VIP hobby computer: Start programming for only $99.







New! VP 111 Microcomputer.... $99. Assembled* and tested.

Features:

- RCA 1802 Microprocessor.
- 1K Bytes static RAM.

Expandable on-board to 4K.
Expandable to 32K Bytes total.

- 512 Byte ROM operating system.
- CHIP-8 interpretive language or machine language programmable.
- Hexidecimal keypad.
- Audio tone generator.
- Single 5-volt operation.
- Video output to monitor or modulator.
- Cassette interface—100 Bytes/sec.
- Instruction Manual with 5 video game listings, schematics, CHIP-8, much more!

Ideal for low-cost control applications.

Expandable to full VIP capability with VP-114 Kit.

*User need only connect cables (included), a 5-volt power supply, and speaker.

New low price! The original VIP.. $199. Completely assembled and tested.

All the features of the VP-111 plus:

- A total of 2K Bytes static RAM.
- Power supply.
- 8 Bit input port.
- 8 Bit output port.
- I/O port connector.
- System expansion connector.
- Built-in speaker.
- Plastic cover.

Three comprehensive manuals:

- VIP Instruction Manual—20 video game listings, schematics, much more.
- VIP User's Guide—operating instructions and CHIP-8 for the beginner.
- RCA 1802 User's Manual (MPM-201B) - complete 1802 reference guide.



COSMAC VIP lets you add computer power a board at a time.

With easy-to-buy options, the versatile RCA COSMAC VIP means even more excitement. More challenges in graphics, games and control functions. For everyone, from youngster to serious hobbyist.

Built around an RCA COSMAC microprocessor, the VIP is easy to program and operate. Powerful CHIP-8 interpretive language gets you into programming the first evening. Complete documentation provided.

Send the coupon now...
Complete the coupon below and mail to: RCA VIP Customer Service, New Holland Avenue, Lancaster, PA 17604.

Or call toll free (800) 233-0094 to place your Master Charge or VISA credit card order. In Pennsylvania, call (717) 397-7661, extension 3179.

Please send me the RCA COSMAC VIP items indicated.

Type	Description	Price
☐ VP-111	New low cost Microcomputer (See description above)	$99
☐ VP-114	Expansion Kit for VP-111—Includes 3K RAM, I/O Port and connectors	$ 76
☐ VP-711	VIP—The original VIP Microcomputer (See description above)	$199
☐ VP-44	RAM On-Board Expansion Kit—Four 2114 RAM IC's. Expands VP 711 memory to 4K bytes	$ 36
☐ VP-590	VIP Color Board—Converts VIP to color. Four background and eight foreground colors	$ 69
☐ VP-595	VIP Simple Sound Board—Provides 256 programmable frequencies. For simple music or sound effects. Includes speaker	$ 30
☐ VP-550	VIP Super Sound Board—Turns your VIP into a music synthesizer! Two independent sound channels. On-board tempo control. Outputs to audio system	$ 49
☐ VP-570	VIP Memory Expansion Board—Plug-in 4K RAM memory	$ 95
☐ VP-580	VIP Auxiliary Keypad—Adds two-player interactive capability. 16-key keypad with cable. Connects to sockets on VP-590 or VP-585	$ 20
☐ VP-585	VIP Keypad Interface Board—Interfaces two VP-580 Auxiliary Keypads to VIP	$ 15
☐ VP-560	VIP EPROM Board—Interfaces two 2716 EPROMs to VIP	$ 34
☐ VP-565	VIP EPROM Programmer Board—Programs 2716 EPROMs. With software	$ 99
☐ VP-575	VIP Expansion Board—Provides 4 buffered and one unbuffered expansion sockets	$ 59
☐ VP-576	VIP Two-Board Expander—Allows use of 2 Accessory Boards in either I/O or Expansion Socket	$ 20
☐ VP-601	ASCII Keyboard—128-character ASCII Encoded alphanumeric keyboard	$ 65
☐ VP-611	ASCII/Numeric Keyboard—Same as VP-601 plus 16 key numeric keypad	$ 80
☐ VP-620	Cable: Connects ASCII keyboards to VIP	$ 20
☐ VP-700	VIP Tiny BASIC ROM Board—BASIC code stored in 4K of ROM	$ 39
☐ VP-710	VIP Game Manual—Listing for 16 exciting games	$ 10
☐ VP-720	VIP Game Manual-II—More exciting games (Available 2nd qtr. '80)	$ 10
☐ MPM-201B	CDP1802 User Manual—(Included with VP-711)	$ 5
☐	Please send more information	—

Enclosed is $______ for items checked plus shipping & handling charge of $3.00.
Add your state and local taxes $______ Total enclosed $______
I enclose ☐ check or ☐ money order or, charge my ☐ VISA/Bank Americard ☐ Master Charge.
Credit card account No. ______
Master Charge Interbank No. ______ Expiration date: ______
Signature (required for credit card orders): ______
Name (please type or print): ______
Street address: ______ City: ______
State & Zip: ______ Telephone: ( ) ______

Make checks payable to RCA Corp. Prices and specifications are subject to change without notice.

Circle 78 on inquiry card.

SCORE AREA

PAGE

	PAGE
1	1
2	5
3	

LINE

	PAGE	LINE	SCALE
1	1	1	1.1
2	1	4	1.5
3	1	7	1
4	1	11	1.3
5	2	14	1.01
6	2	17	1.1
7	2	19	1.02
8	2	23	1.6

MEASURE

	LINE	SCREEN	CHARACTER
1	1	21	1
2	1	75	101
3	1		35
4	2		
14	5		
15	5		
16	5		

CHARACTER

	XLOC	YLOC	LENGTH	SYMBOL
1				
20				
35				
60				
101				
150				

FREE AREA

	CHARACTER	LENGTH
1	20	15
2	60	41
3		

WORK AREA

FROM SCORE

XLOC	YLOC	LENGTH	SYMBOL

FROM SCREEN

XLOC	YLOC	CODE

SCREEN AREA

	XLOC	YLOC	CODE
1			
21			
45			
75			

	SCREEN	LENGTH
1	1	20
2	45	30

Figure 4: *Data structure within the music editor showing the various areas and pointers used in the system. The score area consists of four arrays linked together as a doubly linked list. This allows the user to determine the location of any measure in the score easily. The work area consists of two sets of arrays. One set contains information from the character arrays. The other set contains information about a measure in screen format. The screen area contains information used when the score is displayed on the screen. The free area contains two sets of arrays used to store measures efficiently in the character array and to consolidate fragmented free areas in storage.*

arrays. One set contains information from the character array about a measure. The format of this information is similar to that of the character arrays. The other set of arrays contains information about a measure in screen format. When editing or creating a measure, the changes are made in the work arrays. Any changes made to the score must be made in the score section of the work area and also in the screen area so that the new measure can be displayed to the user. When the user decides that the measure should be permanent, the contents of the work area must be transferred to the character and screen arrays with all format changes, and the pointers in the measure array must be adjusted. Placement of the new measure in both the character and screen arrays is done with a storage allocation procedure that manages the storage in both of these arrays.

The Free Area

The free area contains two sets of arrays. The first set contains information about the free space in the character array. It contains a pointer to the first free word of storage, and an integer representing the number of words of the free area. Figure 4 shows two free areas in the character arrays (indicated by the darkened areas). One starts at index 20 and contains fifteen words, the other at index 60 with forty-one words. If a measure is created or edited and the user wishes to make it a permanent part of the score, a storage procedure determines the length of the measure in the work area and then scans the free area for a contiguous area of storage that is at least that length. It then transfers the measure from the work area to that location and adjusts the values in the free arrays. The description for the second set of arrays in the free area, those for the free areas of the screen array, is completely analogous. After editing a score for an extended period of time, the character and screen arrays will be fragmented with many areas of space that are too small to be useful. This point is detected by the editor, and the routines that compact the space, leaving only one large area of free storage, are executed automatically.

In part 2 of this article I shall give details of the routines which perform the editing.■

Reference

Read, Gardner. *Music Notation: A Manual of Modern Practice*, second edition, Crescendo Publishing Company, Boston, 1969. ISBN 0-87597-080-X



Home control unit for the personal computer!

Interface your computer to the BSR X-10 or Sears Home Control system and control appliances, lamps, and wall switches.

Designed by Steve Ciarcia, featured in January, 1980 BYTE.

Assembled and tested interface, in attractive 8.25 x 6 x 2.5 inch plastic case, with cable and connector for TRS-80* keyboard or expansion interface, power supply, and manual, including BASIC listing for simple control routine for 4K, Level II minimum system. $104.95.

Four year control program, requires expansion interface for real time clock, on BASIC cassette. $19.95.

Package PK 500: BSR X-10 Command Console, cordless controller, two lamp modules and one appliance module. $124.99.

Separate Prices: UC 301 Command Console, $49.95; CC 401 Cordless Remote Controller, $24.99; LM 501 Lamp Module, $16.99; AM 601 Appliance Module, $16.99; WS 701 Wall Switch Module, $16.99.

Note: Your BUSY BOX will not work with the Radio Shack Home Controller, a stripped down version of the BSR X-10.

HARDSIDE

Shipping costs are not included in prices.

To order, call TOLL FREE 1-800-258-1790. (In NH call 673-5144)

6 SOUTH STREET, MILFORD, NH 03055 For more information, call (603)673-5144.

TRS-80* COMPUTERS:

		OUR PRICE
Level I, 4K	$499.00	$449.00
Level II, 4K	$619.00	$559.00
Level II, 16K, no keypad		$669.00
Level II, 16K, w/keypad	$849.00	$769.00

EXPANSION INTERFACES:

Exp. Int., no RAM	$299.00	$269.00
Exp. Int., 16K RAM, (NEC)	$448.00	$369.00
Exp. Int., 32K RAM, (NEC)	$597.00	$459.00

DISK DRIVES:

Percom, TFD-100, 40-tracks	$399.00	$389.00
Percom, Dual TFD-100's	$795.00	$775.00
Percom, TFD-200, 77-tracks	$675.00	$625.00
Percom, Dual TFD-200's	$1350.00	$1250.00

DISK DRIVE ACESSORIES:

2-drive cable for TRS-80*	$29.95	$29.00
4-drive cable for TRS-80*	$39.95	$39.00
Percom Data Separator		$29.95
Extender Card	$15.95	$15.00

We Buy and Sell Used TRS-80*

PRINTERS:

		OUR PRICE
Centronics 730	$999.00	$846.00
Centronics 753-2	$3196.00	$2750.00
Centronics 779-2	$1559.00	$1064.00
RS Quick Printer II	$219.00	$197.00
RS Line Printer III	$1960.00	$1813.00
LRC 7000+(20,32 or 40 col.)	$389.	$369.00
LRC 7000+(64 column)	$405.00	$389.00

PRINTER CABLES:

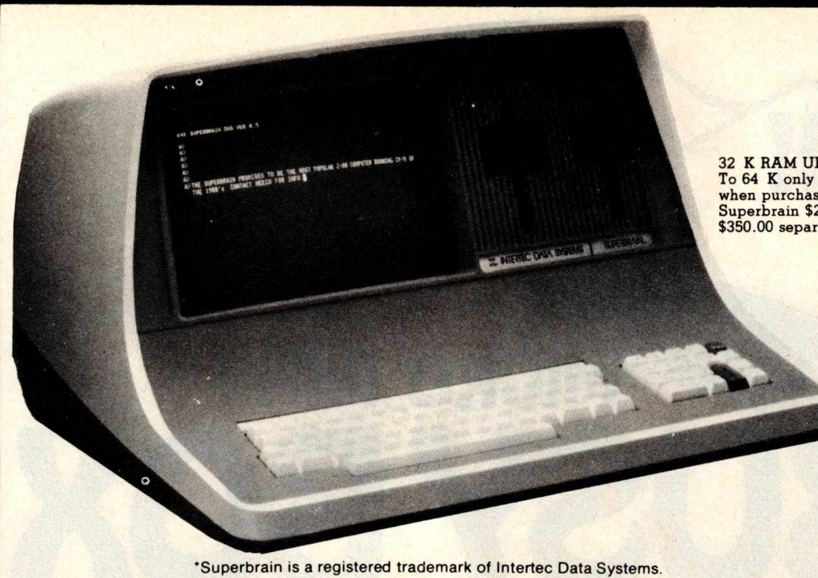
QPII to Exp. Int. cable	$19.00
LRC to TRS-80* cable	$20.00
730 to TRS-80* cable	$29.00
779 or 753 to TRS-80* cable	$35.00

PERIPHERALS:

Novation CAT Modem	$199.95	$179.00
RS-232-C Interface Board	$99.00	$89.00
TRS-232 Printer Interface		$49.95
Data Dubber		$49.95
16K Memory Upgrade Kit, Keyboard		$99.00
16K Memory Upgrade Kit, E.I.		$95.00
Percom Electric Crayon		$249.95
Busy Box		$104.95

Ask for our FREE catalog!

*TRS-80 is a trademark of Radio Shack and Tandy Corp.



*Superbrain is a registered trademark of Intertec Data Systems.

32 K RAM UPGRADE
To 64 K only $250.00
when purchased with a
Superbrain $2995
$350.00 separately

SUPERBRAIN™

The Honor Graduate

OEM's . . .
End Users . . .
Computer Dealers . . .

$2995!

SuperBrain users get exceptional performance for just a fraction of what they'd expect to pay. Standard system features include: two double density mini-floppies with **285 K** bytes of disk storage, **32K of RAM** memory to handle even the most sophisticated programs, a CP/M Disk Operating System with a high powered text editor, assembler, debugger and a disk formator. And, with SuperBrain's S-100 bus adaptor, you can add all the programming power you will ever need . . . even a 10 megabyte disk!

SuperBrain's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application . . . General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing . . . SuperBrain is tops in its class. But best of all, SuperBrain tackles your toughest jobs for less than one-third the cost of other similar systems.

You'll appreciate the careful attention given to every engineering detail. Standard SuperBrain features include: a full ASCII keyboard with numeric pad and user-programmable function keys. A non-glare, dynamically focused, 12-inch CRT for sharp images everywhere on the screen. Twin Z80 microprocessors to insure efficient data transfer to auxiliary peripheral devices. A universal RS-232 communications port for serial data transmission. And, a single board design to make servicing a snap!

Performance and packaging have never been better matched. Your operators will appreciate SuperBrain's good looks. You'll appreciate SuperBrain's outstanding value. Twin Z80A processors, dual double density disk drives, and a high resolution CRT terminal. All in a single, smart looking, self-contained desktop unit. And, all for a price that's substantially less than the competition!

Make no mistake about it. The freshman students in the small systems business can't begin to compete with this year's honor graduate. The SuperBrain. The only system at the top of its class in price and performance

System Specifications

CPU	
Microprocessors	Twin Z80A's with 4MHZ Clock Frequency. One Z80A (the host processor) performs all processor and screen related functions. The second Z80A is "down-loaded" by the host to execute disk I/O. When not processing disk data, the second Z80 may be programmed by the host for other processor related functions.
Word Size	8 bits
Execution Time	1.0 microseconds register to register
Machine Instructions	158
Interrupt Mode	All interrupts are vectored.
Floppy Disk	
Storage Capacity (Shugart drives)	**285K** total bytes formatted on two double density drives. Optional external 10-300 megabyte hard disk storage is available using optional S-100 bus adaptor.
Data Transfer Rate	250K bits/second
Average Access Time	250 milliseconds. 35 milliseconds track-to-track
Media	5 1/4 inch mini-disk
Disk Rotation	300 RPM
Internal Memory	
Dynamic RAM	32K bytes dynamic RAM (standard) 32K memory upgrade available.
Static RAM	256 bytes of static RAM is provided in addition to the main processor RAM. This memory is used for program and/or data storage for the auxiliary processor.
ROM Storage	1K bytes standard. Allows ROM "bootstrapping" of system at power-on. ROM storage is 2708 compatible and may be reprogrammed by the user for custom applications.
CRT	
Display Size	12-inch, dynamically focused. P4 phosphor.
Display Format	25 lines x 80 characters per line.
Character Font	8 x 8 character matrix on a 8 x 12 character field
Line Drawing Characters	Eleven special graphics symbols used for form generation.
Display Presentation	Light characters on a dark background. Reversible through keyboard/program selection.
Bandwidth	20 MHZ.
Cursor	Reversed image (block cursor)
Communications	
Screen Data Transfer	Memory-mapped at 38 kilobaud. Serial transmission of data at rates up to 9600 bps.
Auxiliary Interface	Universal RS-232 asynchronous. Synchronous interface optional.
Parallel Interface	Radio Shack TRS-80 compatible.
S-100 Bus	Printed circuit edge connector provided for connection of optional S-100 bus adaptor.
Transparent Mode	Enables display of all incoming and outgoing control codes.
Parity	Choice of even, odd, marking, or spacing.
Transmission Mode	Half or Full Duplex. One or two stop bits.
Addressable Cursor	Direct positioning by either discrete or absolute addressing.
System Utilities	
Disk Operating System	CP/M
DOS Software	An 8080 disk assembler, debugger, text editor and file handling utilities.
Optional Software	
FORTRAN	ANSI standard. Relocatable, random and sequential disk access.
COBOL	ANSI standard. Relocatable, sequential, relative and indexed disk access.
BASIC	Sequential and random disk access. Full string manipulation, interpreter.
Application Packages	Extensive software development tools are available including software for the following applications: Payroll, Accounts Receivable, Accounts Payable, Inventory Control, General Ledger and Word Processing.
Keyboard	
Alphanumeric Character	Generates all 128 upper and lower case ASCII characters.
Special Features	N-Key Rollover, Automatic repeat (at 15 CPS), Keyboard lock/unlock.
Numeric Pad	0-9, decimal point, comma, minus and four user-programmable function keys.
Special Functions Keys	Up to 64 user-defined two-key function sequences.
Cursor Control	Up, down, forward, backward, and home.
Internal Construction	
Cabinetry	Structural foam
Component Layout	Two board modular design. All processor related functions and hardware are on a single printed circuit board. All video and power related circuits on a separate single board. These two boards are interconnected via a single 22-pin ribbon cable.
Mounting	CRT and two circuit boards mounted to base. CRT in a rigid steel frame. Disk Drive assembly mounted into upper cover for ease of servicing.
Environment	
Weight	Approximately 45 pounds
Physical Dimensions	14 5/8" (H) x 21 3/8 (W) x 23 1/8 (D)
Environment	Operating: 0° to 50° C Storage: 0° to 85° C; 10 to 95% rel. humidity - non condensing.
Power Requirements	115 VAC, 60 HZ, 1 AMP (optional 230VAC/50HZ model available)

*Specifications subject to change without notice

DEALER/OEM QUANTITIES AND SPECIAL PRICING AVAILABLE VIA MICROAMERICA DISTRIBUTING



Microcomputer Systems Division

NEECO
679 Highland Ave.
Needham, MA
02194

Mon-Fri 9:30-5:30
MasterCharge &
Visa Accepted

(617) 449-1760
Telex: 951021

MICROAMERICA DISTRIBUTING
"SuperBrain Dealer/O.E.M. Inquiries invited"
21 Putnam Street
Needham, MA
02194

(617) 449-4310

Circle 265 for microamerica

Circle 80 for NEECO

The Great Race and Micro Disk Files

Horse Race Simulations

Joseph J Roehrig
JJR Data Research
POB 74
Middle Village NY 11379

The purpose of this article is to present a sophisticated horse racing game and to demonstrate the use of sequential and random access disk files. The first part of the article will describe the racing simulation, while the second part will detail the implementation of disk files, including the computer time required for certain operations. In addition, the second part will illustrate how the horse racing model can be utilized without using disk files, while limiting the memory requirements.

The Race game was written in North Star BASIC for a system having an 8080 processor, a video terminal, and 32 K bytes of memory. The program contains numerous subroutines, and memory can be saved by eliminating some of them. However, each deletion of a subroutine will also cause the loss of one of the game's features.

Listing 1 shows the available free memory (19,756 bytes) after loading BASIC and before program RACE is entered. Once RACE is entered and the RUN command is typed, the computer begins to solicit information that is necessary for the program's execution. A random number (the sample shows 7 being input) and the number of horses in the simulation are requested. The number of horses can range anywhere from one to forty. However, a minimum of four horses is necessary to simulate the running of most races. In addition, the program always uses an even number of horses. Therefore, all odd numbered responses are incremented by 1. The next entry is for the file name containing the data. RACE-D is input for the sample run (the setup of this file and the file structure will be discussed later).

All of the preliminary data is now input and the user is ready to choose any one of four possible actions: 0 to end, 1 for a list of horses, 2 for statistics, or 3 to run a race. In listing 1, a "1" is input. This causes the free memory space to be printed (now only 3726 bytes, telling us that the program is already occupying 16,030 bytes of memory), along with a list of the horses. An identification number, name, races run, races won, races placed second, races finished third and dollars earned is printed for each horse. All results in the sample are zero because we started with a blank file: RACE-D.

After printing the requested data, the computer branches back to the action code selection area. This time a race is the desired action and a "3" is input. The computer prints the six types of races that can be run, the possible distances (six to twelve furlongs with a furlong equaling ⅛ of a mile), and the maximum number of horses: twelve. The minimum number of horses for all types of races is four, except for the condition which corresponds to a workout, in which one horse is the minimum. Historical data is maintained for all races except workouts. The sample input is 4,8,12, corresponding to a maiden race (only horses who have never won a race are eligible) of eight furlongs, with a maximum of twelve horses being entered. The computer then branches to the automatic horse selection portion of the program. This mode is always entered for maiden and conditioned races and can be optionally used for other types of races.

In the automatic mode, the computer selects the horses to be entered into the race. The horses with the highest earnings-per-race ratio between two user-supplied identification numbers are selected. There are two exceptions: in maiden races only nonwinners can be chosen, and for handicap races the horses with the least earnings-per-race ratio are picked. Listing 1 shows the computer asking for the start and end identification numbers for the search and the user supplying "0,8". This response offers only nine possible horses for the race (the horses from identification number 0 to number 8). The program selects all nine horses, since none have ever won, or for that matter entered a race.

A list of the entries is then printed, giving the post positions, names, weights, odds, and historical data. The weights will always be 120 pounds, with the exception of allowance and handicap races where the computer calculates weights to handicap the horses. The odds are given as odds to win against each dollar bet. Therefore, odds of $5 pay $12 for a successful $2 win bet.

At this point the user can decide to

Text continued on page 146

Listing 1: *This listing shows a request first for a list of horses, and then calls to start a race. In response to that request, the user must specify the type of race, the distance, and the number of horses in the race. Finally, the user must provide the start and end point for a search for eligible horses. A list of entries and statistics are then displayed for each horse in the race. Now hit the return key and "They're off!"*

```
!FREE(0)
 19756
READY
LOAD RACE
READY
RUN

RANDOM NUM ? 7
# OF HORSES ? 12
FILE: RACE-D

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1            3726

ID NAME        R#  1  2  3     $ WON ID NAME        R#  1  2  3     $ WON
=========================================================================
 0 BUCKPASSER  0   0  0  0       $0.  6 SECRETARIT  0   0  0  0       $0.
 1 DAMASCUS--  0   0  0  0       $0.  7 FOOLISH PL  0   0  0  0       $0.
 2 DR FAGER--  0   0  0  0       $0.  8 RUFFIAN---  0   0  0  0       $0.
 3 RIVA RIDGE  0   0  0  0       $0.  9 BOLD RULER  0   0  0  0       $0.
 4 SUE'S GIRL  0   0  0  0       $0. 10 GALLANT MA  0   0  0  0       $0.
 5 FOREGO----  0   0  0  0       $0. 11 ROUND TABL  0   0  0  0       $0.
READY TO RETURN ?

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3            3669

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 4,8,12
ID START & ID END SEARCH ? 0,8
POST  1  RUFFIAN---
POST  2  FOOLISH PL
POST  3  SECRETARIT
POST  4  FOREGO----
POST  5  SUE'S GIRL
POST  6  RIVA RIDGE
POST  7  DR FAGER--
POST  8  DAMASCUS--
POST  9  BUCKPASSER

THIS IS A 8 FURLONG MAIDEN  RACE WITH A PURSE OF $ 31000

POST NAME        WGH    ODDS  R# 1ST 2ND 3RD   EARNINGS
=======================================================
   1 RUFFIAN--- 120   $5.00   0   0   0   0       $0.
   2 FOOLISH PL 120  $16.40   0   0   0   0       $0.
   3 SECRETARIT 120   $4.00   0   0   0   0       $0.
   4 FOREGO---- 120   $5.80   0   0   0   0       $0.
   5 SUE'S GIRL 120  $68.60   0   0   0   0       $0.
   6 RIVA RIDGE 120   $5.00   0   0   0   0       $0.
   7 DR FAGER-- 120   $4.00   0   0   0   0       $0.
   8 DAMASCUS-- 120   $8.80   0   0   0   0       $0.
   9 BUCKPASSER 120   $5.80   0   0   0   0       $0.

RETURN FOR RACE OR ANYTHING TO KILL ?
```

Listing 2: *The running of the first race. The : markings on the track indicate the furlong divisions. The I markings form the finish line. The results below the track are printed upon completion of the race, then the newly created data is stored on file RACE-D.*

```
             :............:............:............:............:6....
           ..:............:............:............:............:5......
         ....:............:............8............:............:4........
       ......:............:............7............:............:39.........
       ......4............:..........26.9...........:............:28.........
       ...6392..5.........:..........13.45..........:............:17.........
       ...87                                                      ......
     ....1                                                          ......
  ......                                                                  ......
......                  DAMASCUS---(# 8)      RUFFIAN----(# 1)              ::::::
......                  SECRETARIT(# 3)       FOOLISH PL(# 2)               ......
......                  FOREGO-----(# 4)      SUE'S GIRL(# 5)               ......
......                  BUCKPASSER(# 9)                                     ......
......                  DR FAGER--(# 7)                                     ......
::::::                  RIVA RIDGE(# 6)                                     ......
  ......                                                                  ......
     ......                                                             ......
       ......                                                         ......
       .........2.4961........:............I17..3......:...........:........
       .........5.:..8........:............569..8......:...........:........
       ...........:..3........:............2.4.........:...........:........
         .........:..7........:............I...........:...........:.......
            ......:...........:............I...........:...........:......
              ....:...........:............I...........:...........:?

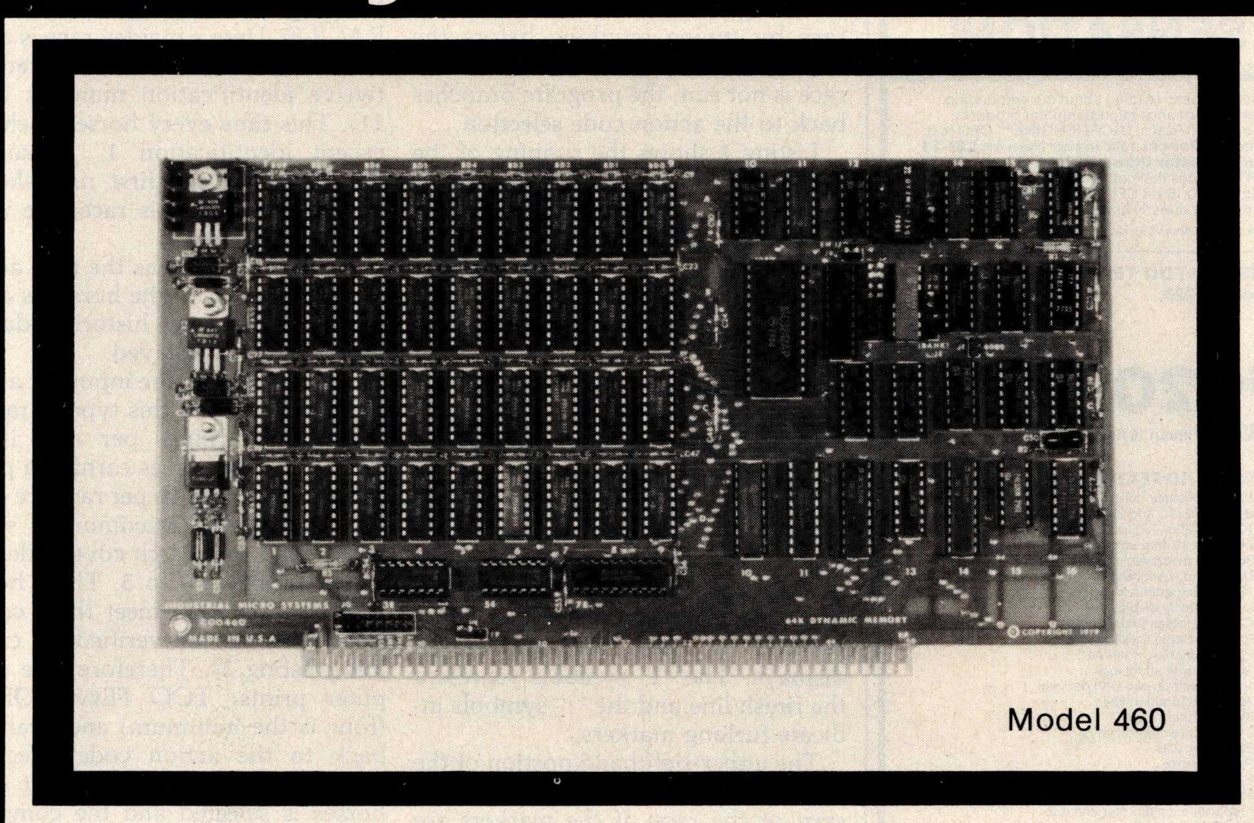

ID NAME          WT   P  S  H  S  F BY  L M:SS.F      ODDS
==========================================================
 1 DAMASCUS---  120   8  3  3  3  1 BY  0 1:33.2      8.80
 6 SECRETARIT   120   3  6  4  2  2 BY  0 1:33.2      4.00
 5 FOREGO-----  120   4  8  6  7  3 BY  3 1:34.0      5.80
 0 BUCKPASSER   120   9  7  7  6  4 BY  3 1:34.0      5.80
 2 DR FAGER--   120   7  4  5  1  5 BY  3 1:34.0      4.00
 3 RIVA RIDGE   120   6  5  2  5  6 BY  4 1:34.1      5.00
 8 RUFFIAN----  120   1  2  1  4  7 BY  4 1:34.1      5.00
 7 FOOLISH PL   120   2  1  8  9  8 BY  5 1:34.2     16.40
 4 SUE'S GIRL   120   5  9  9  8  9 BY  5 1:34.2     68.60

POST       WIN      PLACE      SHOW
   8    $19.60     $10.80     $3.40
   3                $6.00     $2.80
   4                          $3.00

READY?


1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 0          3453
READY
```

The Dynamic RAM...


Model 460

...you've been waiting for.

QUALITY

For years you've looked to Industrial Micro Systems for quality S100 Static RAM boards. Now that same quality is available in the Model 460, our new Dynamic RAM board. The 460 combines the low power consumption and lower cost of dynamic RAM with Industrial Micro Systems high standard of quality and reliability.

PARITY

To ensure data reliability, the Model 460 is equipped with parity. The parity error line is shunt selectable to a number of interrupt lines for software control, or it can halt the CPU in a wait state. An LED on the board is lit when a parity error occurs.

MEMORY MANAGEMENT

The Model 460 is organized into 4 blocks of 16K bytes each. Each block is individually selectable under program control for memory management beyond 64K.

HIGH PERFORMANCE FEATURES

The Model 460 operates at 4MHZ with no wait states. It also utilizes on board "hidden refresh" circuitry for improved throughput.

Parity, memory management, Industrial Micro Systems quality...its all here.

You've waited long enough for a quality S100 Dynamic RAM board. See your Industrial Micro Systems Dealer today.

INDUSTRIAL MICRO SYSTEMS

Marketing Office
628 N. Eckhoff
Orange, CA 92668
(714) 978-6966

CONTACT FOR DEALER LISTING

Manufacturing
2800 Lockheed Way
Carson City, NV 89701
(702) 883-7611

Text continued from page 142:

run the race as described by entering a carriage return, or can abort the race by typing anything before the carriage return is transmitted. If the race is not run, the program branches back to the action code selection.

Listing 2 shows the running of the race. A screen depicting the race is printed at various points. The number of screens printed for each race equals:

$$1 + \frac{(\text{distance in furlongs} + 1)}{2}$$

All fractions are truncated. The display was set up for use on a 24-line by 80-character terminal. Best results are obtained when running at 19,200 bps, causing the display to appear rapidly. For the sample run, the program was edited to show the track display only once, and to print all positions that would have been printed in the five individual displays. The "I" symbols represent the finish line and the ":" symbols indicate furlong markers.

The upper-righthand portion of the display represents the horses at the start of the race. If the markers are counted, you can see that the horses (depicted by numbers) are eight furlongs from the finish line. In the center of the track the horses are listed by name and post position, in order of finish. During the race, the display prints the names in racing order (first horse, second, third, etc). If twelve horses race, post positions 10 to 12 are represented by 0, A, and B, respectively. After the last display of the track is printed, a "?" appears. Any input or a return will cause the program to print the chart of the race.

The chart of the race is similar to newspaper reports that describe actual races. This chart shows the identification number, name, weight carried, post position, position at the start, half, stretch and finish, length behind the winner, and time and odds for each horse that participated in the running of the race. This is followed by the win, place, and show payoffs for the three horses finishing third or better. The computer asks if you are finished with this display by printing READY ?. Any input branches the program to the action code selection. Here a "0" is entered to end the race, and the program completes its execution by writing the newly created data to file RACE-D.

Listing 3 shows a second running of the program using the same data file: RACE-D. Here a maiden race is again selected, but the search covers all twelve identification numbers (0 to 11). This time every horse is selected except identification 1, Damascus, the winner of the first race shown. Rather than run this race, the word "kill" is entered.

A "1" is selected as the next action code, and a list of the horses is again printed. This time, historical data is on file and is displayed.

Listing 4 shows the input for a conditioned race. For this type of race, a maximum earnings per race is requested. Only horses earning a particular amount or less per race are eligible to race. The maximum is set at $1000, and the search covers identification numbers 0 to 5. Three horses in the search area meet these conditions (this can be verified by examining listing 3). Therefore, the computer prints: TOO FEW HORSES (four is the minimum) and branches back to the action code selection. This time a handicap race for eight horses is selected and the computer chooses the eight horses who have no earnings.

In listing 5, a stake race is selected. Here, the user can choose between an automatic or a manual selection of horses. "YES" is input in response to the question: YES FOR AUTOMATIC SELECT?, and the program again branches to the automatic selection portion of the program. Again the user decides not to run this particular race. The bottom of this listing shows a stake race being set up without using the automatic selection process. After each post position number is printed, the user supplies a horse's identification number.

At this point, I turned off the printer and ran a number of races. All of the historical information for these races was again stored in file RACE-D. Listing 6 shows program RACE being executed, but this time a more adequate supply of historical data is available. Action code 1 is entered and the list of horses is displayed. Action code 2 is now entered for the first time. This code gives statistics for the individual horses. After the "2" is input, the computer asks: ID#?, and the user supplies the identifica-

Text continued on page 156

Of course our Floppys aren't cheap. Quality never is.

It's no use trying to hide the fact: Maxell Floppy Disks give you the finest quality you can buy no matter how much you spend. And more and more of you are agreeing that your data is worth our perfection.

Our floppys work better with your drive.

Naturally, our floppys conform to ISO and IBM specifications. More important, they have also been approved by major OEMs, the people who recommend only those few floppys they are certain will work best with their hardware. So although we obviously don't know which drive system you are using, it makes no difference. Maxell Floppy Disks are so good they actually work better with *any* drive.

What it all means for you.

Yes, you can pay less for some other floppys. But lost data is a terrible price to pay when quality is what you want. And Maxell Floppy Disks help you profit in the very parameters you use this medium for: storing more data with virtually no down-time.

The level of modulation uniformity in every Maxell floppy is vital to double density recording and readout. It means no peak shift, complete freedom from dropouts, total absence of particle orientation. Plus longer life, greater overall durability, and significantly less oxide build-up and head abrasion.

So when you have to depend on full data retrieval, a few cents can make a big difference. Depend on Maxell Floppy Disks. They can really save you.

Maxell offers the full range of Floppy Disks from standard 8-inch to 5¼-inch plus Data Cassettes. *Dealer inquiries invited.*



maxell®
DATA PRODUCTS
The Quality Alternative

Maxell Corporation of America, Data Products Group
60 Oxford Drive, Moonachie, NJ 07074 Tel. (201) 440-8020

Circle 84 on inquiry card.

Listing 3: *Here we initialize the running of the second race. At this time we do not begin the race, but check for the current status of the RACE-D file to verify that the data from the first race has been stored.*

```
TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 4,7,12
ID START & ID END SEARCH ? 0,11
POST  1  SECRETARIT
POST  2  FOREGO-----
POST  3  BUCKPASSER
POST  4  ROUND TABL
POST  5  GALLANT MA
POST  6  BOLD RULER
POST  7  RUFFIAN----
POST  8  FOOLISH PL
POST  9  SUE'S GIRL
POST 10  RIVA RIDGE
POST 11  DR FAGER---

THIS IS A 7 FURLONG MAIDEN   RACE WITH A PURSE OF $ 44000

POST NAME        WGH    ODDS  R# 1ST 2ND 3RD    EARNINGS
=========================================================
  1 SECRETARIT 120   $5.20   1   0   1   0     $6200.
  2 FOREGO----- 120  $7.40   1   0   0   1     $3100.
  3 BUCKPASSER 120   $7.40   1   0   0   0     $1550.
  4 ROUND TABL 120  $11.00   0   0   0   0        $0.
  5 GALLANT MA 120  $11.00   0   0   0   0        $0.
  6 BOLD RULER 120   $7.40   0   0   0   0        $0.
  7 RUFFIAN---- 120  $6.20   1   0   0   0        $0.
  8 FOOLISH PL 120  $20.00   1   0   0   0        $0.
  9 SUE'S GIRL 120  $83.00   1   0   0   0        $0.
 10 RIVA RIDGE 120   $6.20   1   0   0   0        $0.
 11 DR FAGER--- 120  $5.20   1   0   0   0        $0.

RETURN FOR RACE OR ANYTHING TO KILL ? KILL

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1        3589

ID NAME       R#  1  2  3    $ WON ID NAME       R#  1  2  3    $ WON
=======================================================================
 0 BUCKPASSER  1  0  0  0   $1550.  6 SECRETARIT  1  0  1  0   $6200.
 1 DAMASCUS--- 1  1  0  0  $20150.  7 FOOLISH PL  1  0  0  0      $0.
 2 DR FAGER--- 1  0  0  0      $0.  8 RUFFIAN---- 1  0  0  0      $0.
 3 RIVA RIDGE  1  0  0  0      $0.  9 BOLD RULER  0  0  0  0      $0.
 4 SUE'S GIRL  1  0  0  0      $0. 10 GALLANT MA  0  0  0  0      $0.
 5 FOREGO----- 1  0  0  1   $3100. 11 ROUND TABL  0  0  0  0      $0.
READY TO RETURN ?
```

Listing 4: *Listing of the input for a conditional race. Only three eligible horses are found in the search, too few for a race, so the computer subsequently prints TOO FEW HORSES. Next a request for the running of a handicapped race is entered. Here the computer selects eight horses who have no earnings.*

```
TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 3,9,6
MAX $/RACE EARNED ? 1000
ID START & ID END SEARCH ? 0,5
POST  1  SUE'S GIRL
POST  2  RIVA RIDGE
POST  3  DR FAGER---

THIS IS A 9 FURLONG CONDIT.  RACE WITH A PURSE OF $ 17000

POST NAME       WGH     ODDS  R# 1ST 2ND 3RD   EARNINGS
=================================================================
   1 SUE'S GIRL 120   $21.20   1   0   0   0          $0.
   2 RIVA RIDGE 120     $.40   1   0   0   0          $0.
   3 DR FAGER-- 120    $1.00   1   0   0   0          $0.

TOO FEW HORSES

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3          3589

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 5,10,8
YES FOR AUTOMATIC SELECT. ? YES
ID START & ID END SEARCH ? 0,11
POST  1  ROUND TABL
POST  2  GALLANT MA
POST  3  BOLD RULER
POST  4  RUFFIAN---
POST  5  FOOLISH PL
POST  6  SUE'S GIRL
POST  7  RIVA RIDGE
POST  8  DR FAGER---

THIS IS A 10 FURLONG HANDICAP RACE WITH A PURSE OF $ 13000

POST NAME       WGH     ODDS  R# 1ST 2ND 3RD   EARNINGS
=================================================================
   1 ROUND TABL 120    $4.80   0   0   0   0          $0.
   2 GALLANT MA 120    $3.40   0   0   0   0          $0.
   3 BOLD RULER 120    $8.00   0   0   0   0          $0.
   4 RUFFIAN--- 121    $8.00   1   0   0   0          $0.
   5 FOOLISH PL 119    $4.80   1   0   0   0          $0.
   6 SUE'S GIRL 118    $5.60   1   0   0   0          $0.
   7 RIVA RIDGE 121    $6.00   1   0   0   0          $0.
   8 DR FAGER-- 121    $8.00   1   0   0   0          $0.

RETURN FOR RACE OR ANYTHING TO KILL ?
```

The Place To Buy Computers

CROMEMCO Z-2H HARD DISK



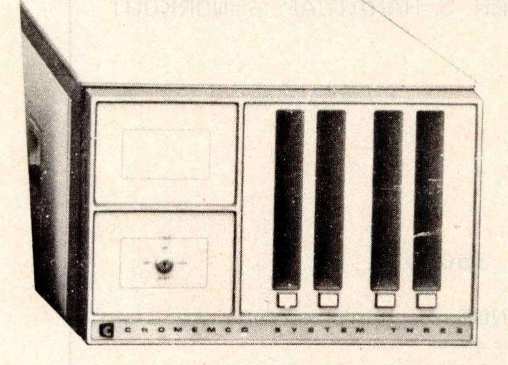
• Full 11-megabyte hard disk system • fast Z80A 4 MHz processor • two floppy disk drives • 64K RAM memory • RS232 special interface • printer interface • extensive software available

List $9995 . . .OUR PRICE ONLY **$8489**

CROMEMCO HDD

11/22 megabyte hard disk for use with existing systems. DMA controller, transfer rate of 5.6 megabytes/sec.

HDD-11, List $6995 . . OUR PRICE $ 5,939
HDD-22, List $11,995 10,189



CROMEMCO SYSTEM 3

— NOW DOUBLE THE CAPACITY! —

Features 4 MHz CPU, 64K of RAM, dual-sided PerSci 299B floppy disk drive (provision for installing a second 299B), RS232C interface, printer interface. All Cromemco systems are assembled and tested, ready to use.

With 64K of RAM, List $6990 *$5890*

CROMEMCO SYSTEM 2

NOW DOUBLE THE CAPACITY
(with double-sided drives)

With 64K of RAM, two minifloppy disk drives, RS232 interface and printer interface board.

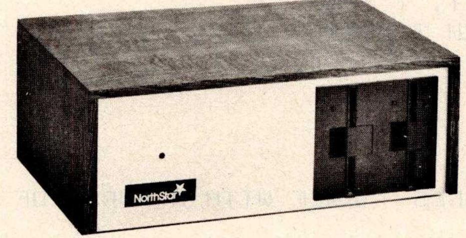
System 2 w/64K RAM, List $3990 . . . . . . $3390

CROMEMCO Z-2

Can be rack mounted. Z-80 processor, 21 slots, power supply, front cover panel. Includes fan and all edge connectors. Assembled and tested.

Z-2W, Assem., List $995 . . . . $845

NORTH STAR HORIZON



HORIZON 1 KITS —

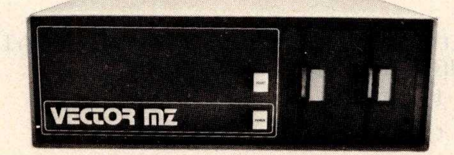
32K, Double Density, List $1849 . . 1684
32K, Quad Density, List $2049 . . . 1869

HORIZON 2 KITS —

32K, Double Density, List $2249 . . 2034
32K, Quad Density, List $2629 . . . 2359

Kits incl. 12 edge connectors, 2 serial ports, parallel port and extra drive cable. (Subject to availability and price changes.) Call or write for low prices on assembled units.

VECTOR MZ



Now 64K with Bank Select — Complete Peachtree Business Software Package also available — Call for details.

INTER SYSTEMS

(formerly ITHACA AUDIO)



The new series II CPO Board features a 4 MHz Z-80A CPU and a full feature front panel. 20-slot actively terminated motherboard, with 25-amp power supply (50/60 HZ operation, incl. 68 cfm fan).

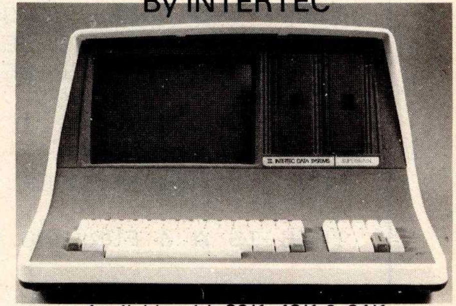
DPS-1, List $1495 . . . . OUR PRICE $1299

SD SYSTEMS

SDS-100, w/32K RAM, $6995. ONLY $5945
SDS-200, List $8995 7645

SUPERBRAIN®

By INTERTEC



Available with 32K, 48K & 64K

Totally self-contained in a single box; 32K, 48K, or 64K Version; Uses two Z-80 CPU's; Commercial-type terminal with 12" monitor (like the Intertube); Dual double-density minifloppies w/360 Kilobytes of storage capacity; I/O ports included; Expandable (if needed) with an external S-100 bus interface; Comes with CP/M™ operating system; extensive software support.

w/32K of RAM, List $2995 . . ONLY $2685
w/64K of RAM $2883

DYNABYTE

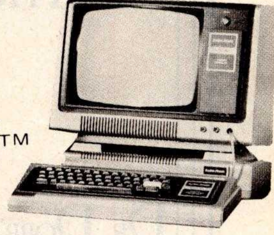


48K and 64K models, single and double density, dual mini disk (77 track), standard 8" and dual-sided 8" systems. *SAVE 15%*

HEATH

WH-89 — All-in-one computer. Features two Z-80's, 16K to 48K. Call or write for prices.

RADIO SHACK TRS-80™



10% OFF

WRITE FOR FREE CATALOG

Above prices reflect a 2% cash discount (prepaid prior to shipment). Add 2% to these prices for credit cards, C.O.D., etc. Prices are f.o.b. shipping point. Prices are subject to change and offers subject to withdrawal without notice.

MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 86 on inquiry card.

Listing 5: *An illustration of the automatic selection option provided in the running of the stake race. First the automatic selection process is chosen and the computer selects four entries, then the user decides to select each entry individually from the RACE-D file.*

```
TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 1,6,4
YES FOR AUTOMATIC SELECT. ? YES
ID START & ID END SEARCH ? 0,11
POST  1   DAMASCUS--
POST  2   SECRETARIT
POST  3   FOREGO----
POST  4   BUCKPASSER

THIS IS A 6 FURLONG STAKES   RACE WITH A PURSE OF $ 36000

POST NAME       WGH    ODDS   R# 1ST 2ND 3RD   EARNINGS
=========================================================
   1 DAMASCUS-- 120   $8.00   1   1   0   0    $20150.
   2 SECRETARIT 120    $.60   1   0   1   0     $6200.
   3 FOREGO---- 120   $3.20   1   0   0   1     $3100.
   4 BUCKPASSER 120   $3.20   1   0   0   0     $1550.

RETURN FOR RACE OR ANYTHING TO KILL ? KILL

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 3          3589

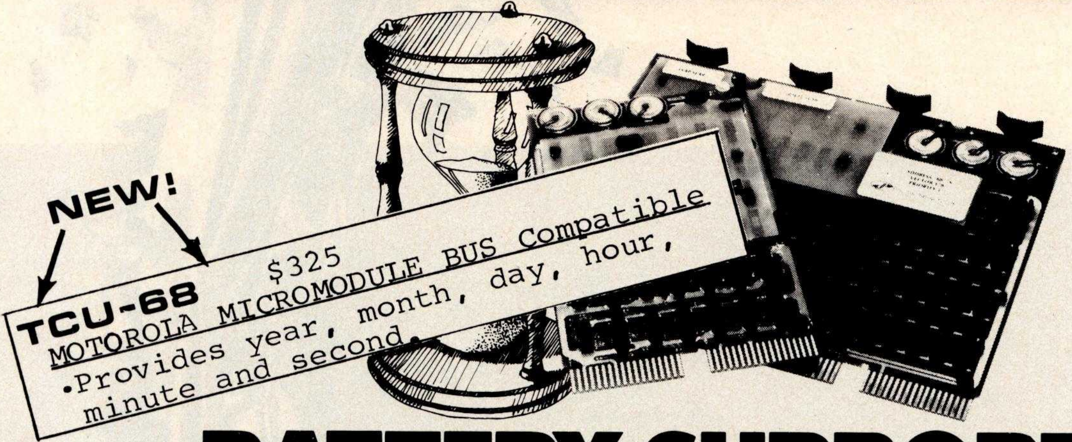
TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 1,6,4
YES FOR AUTOMATIC SELECT. ?
POST  1 ID#? 7
POST  2 ID#? 8
POST  3 ID#? 9
POST  4 ID#? 10

THIS IS A 6 FURLONG STAKES   RACE WITH A PURSE OF $ 35000

POST NAME       WGH    ODDS   R# 1ST 2ND 3RD   EARNINGS
=========================================================
   1 FOOLISH PL 120   $9.00   1   0   0   0         $0.
   2 RUFFIAN--- 120    $.60   1   0   0   0         $0.
   3 BOLD RULER 120   $1.60   0   0   0   0         $0.
   4 GALLANT MA 120   $9.00   0   0   0   0         $0.

RETURN FOR RACE OR ANYTHING TO KILL ?
```

TIME after TIME



BATTERY SUPPORTED CALENDAR CLOCKS

PDP-11*

TCU-100 • $495
- Provides month, day, hour, minute and second.
- Can interrupt on date/time, or periodic intervals.

TCU-150 • $460
- Provides year, month, day, hour, minute and second.
- Automatic leap year.
- Patches for RSX-11M, RT-11 FB/SJ VO2, VO3 and UNIX.

LSI-11/2*

TCU-50D • $325
- Provides month, day, hour, minute and second.
- Dual size board.
- Patches for RT-11 SJ/FB VO2, VO3B.

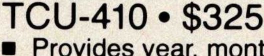
Lockheed SUE

TCU-200 • $550
- Provides year, month, day, hour, minute, second and milli-second.
- Interval interrupts between 1/1024 seconds and 64 seconds.

Computer Automation (Naked Mini)

TCU-310 • $385
- Provides year, month, day, hour, minute and second.

Multi-Bus**



TCU-410 • $325
- Provides year, month, day, hour, minute and second.
- SBC/BLC compatible.

HP 2100

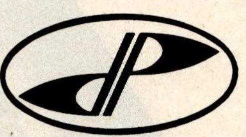
TCU-2100 • $395
- Correct time restored after power failure.
- Compatible with the HP TBG card.

Serial Clock (RS 232 or 20 mA)

SLC-1 • $640
- Connects between any terminal and host computer.
- Provides date, time and more!

All Digital Pathways TCUs have on board NICAD batteries to maintain time and date during power down. Timing is provided by a crystal controlled oscillator. Prices are U.S. domestic single piece. Quantity discounts available.

For more information on these products, contact:
Digital Pathways Inc.
4151 Middlefield Road
Palo Alto, CA 94306
Phone: (415) 493-5544



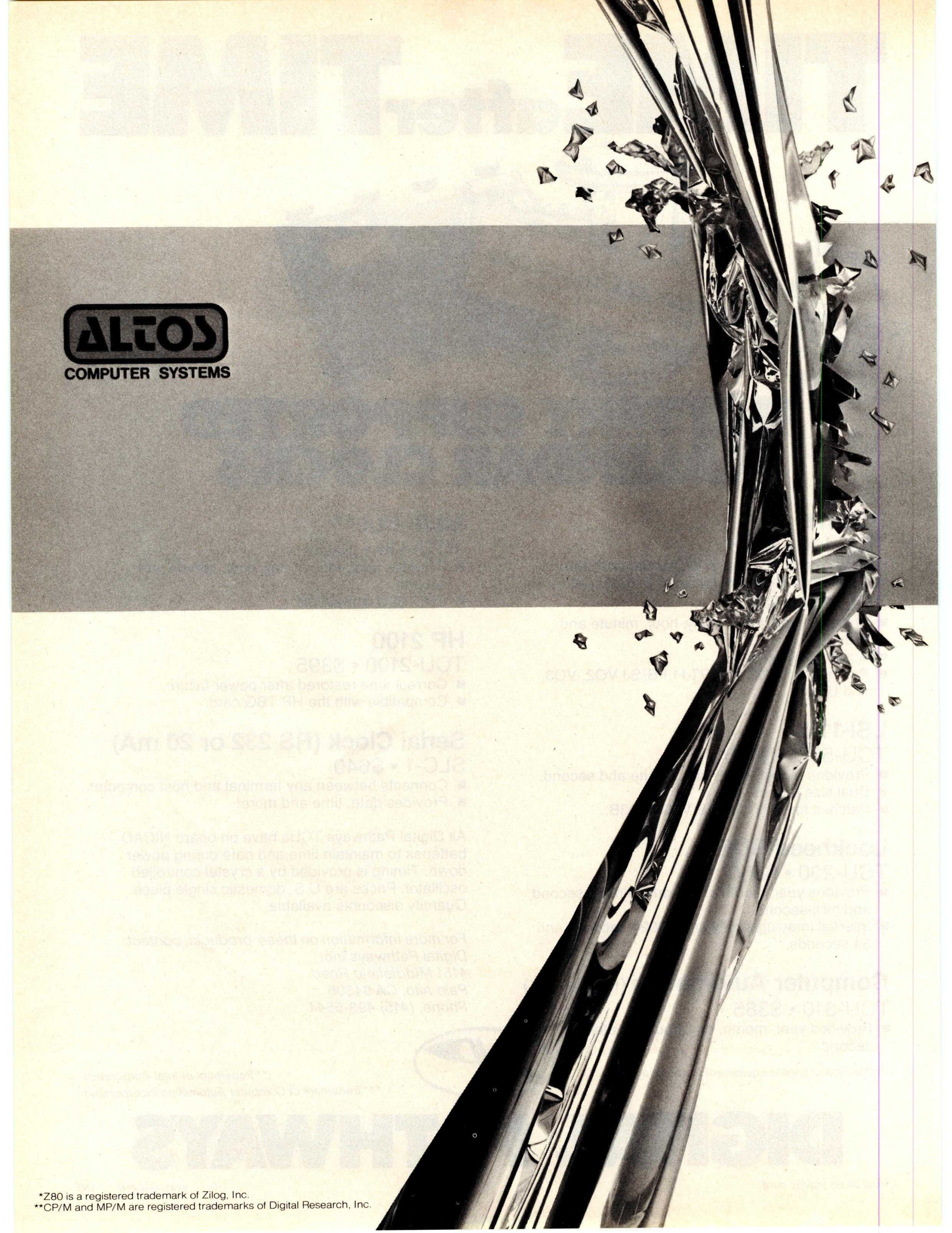
**Trademark of Digital Equipment Corporation*

***Trademark of Intel Corporation*

****Trademark of Computer Automation Incorporated*

DIGITAL PATHWAYS

Circle 88 on inquiry card.


ALTOS
COMPUTER SYSTEMS
*Z80 is a registered trademark of Zilog, Inc.
**CP/M and MP/M are registered trademarks of Digital Research, Inc.

ALTOS BREAKS THE MICRO BARRIER.

Yesterday, microcomputer meant micro performance. Once you outgrew it, you had to step up to a mini. Which meant a big step up in price.

Today, there's the new Altos ACS8000-6 single-board microcomputer system.

It's the first system for the OEM, small businessman and personal user, that offers minicomputer performance and minicomputer storage capacities—at a microcomputer price.

MULTI-USER, WINCHESTER STORAGE, FLOPPY BACK UP: $14,260.

The new Altos ACS8000-6 is a highly advanced Z80* based microcomputer system with high-speed RAM, floppy disk and Winchester hard-disk controllers, DMA, six serial and two parallel I/O ports and the AMD 9511 floating point processor all on a single board. A typical four-user system configuration with two megabytes of Shugart floppy and 29.0 megabytes of Shugart Winchester storage, including CPU and 208K bytes of RAM, costs only $14,260—compared to $30,000 or more for a similar minicomputer system. And that adds up to mini performance at less than half the cost!

MULTI-USER EXECUTIVE SUPPORTS FOUR INDEPENDENT USERS RUNNING CP/M COMPATIBLE PROGRAMS.**

This revolutionary new microcomputer system features the MP/M** Multi-User Executive software program that's unique in two ways. It includes a multi-user CP/M capability and the ability to handle Winchester-type hard disks. The advanced Z80 operating program supports four independent CP/M compatible programs in any of six popular languages: BASIC, FORTRAN, COBOL, PASCAL, APL, C, and a large assortment of additional business application packages. MP/M is compatible with both the 1.4 and 2.0 versions of Digital Research's CP/M, which means programs based on either version can run under MP/M without modification.

With MP/M at the helm, your Altos ACS8000-6 system can support up to four simultaneous users with 48K bytes of RAM each plus 58 megabytes of Winchester storage and 4 megabytes of floppy back up. And that adds up to the first microcomputer to give you the power and performance of a minicomputer.

SINGLE-USER, HARD-DISK SYSTEMS START AT $9450.

The Altos ACS8000-6 series. It's a barrier breaker in every sense. Our entry-level, single-user, hard-disc system with floppy back up is priced under $10,000 and even our 4-user CP/M model is available for under $12,000. And all configurations are easily upgraded. For specific details about pricing or performance, call or write: Altos Computer Systems, 2360 Bering Drive, San Jose, CA (408) 946-6700. TELEX 171562 ALTOS SNA.

Circle 89 on inquiry card.



COMPUTER SYSTEMS

Horse Statistics

- *DAY :* *Each time a race is run a number is assigned in sequence from 0 to 99. This number is called the date. Note that only one hundred races can be run in the file storage space made available by the program.*
- *RACE T :* *The type of race.*
- *PURSE :* *The dollar purse value assigned to the race by the computer.*
- *#H :* *The number of horses that actually participated in the running of the race.*
- *DIS :* *The distance of the race in furlongs.*
- *TIME :* *The time that won the race. All times are given as minutes : seconds. fifths of seconds. In all horse racing a 0.2 equals $^2/_5$ of a second not $^2/_{10}$.*
- *WGH :* *The weight that the horse carried in pounds.*
- *P :* *Post position.*
- *S,H,S,F :* *The position of the horse at the start, half, stretch, and finish.*
- *L :* *How many lengths the horse lost the race by, or how many lengths the horse won by if it finished first.*
- *TIME :* *The time it took for the horse to run the race.*
- *ODDS :* *The odds of the horse winning the race.*
- *WINNER :* *Which horse won the race. In the sample runs, I had both twelve and forty horses as the number of horses available to run during a particular execution of the program. If a twelve-horse run is selected after a forty-horse run of the program, and past performances require a name of a horse not contained in the twelve, ------- is printed.*

Text continued from page 146:

tion number of the horse whose past performances are to be reviewed. In the sample run, "6" was entered and Secretariat's past performances are displayed. The information given, aside from the same data as supplied by action code 1, is explained in the text box at left.

In the case of Secretariat, his last ten races are printed, with the most recent appearing first. Ten is the maximum number of past performance races that are stored for each horse. If day 0 is examined for Secretariat, you will see that the data is identical to that shown in listing 2 for Secretariat. Listing 2 is the sample race that shows the running of the day 0 race.

What happens when a horse runs in its eleventh race? The least current race is dropped and the most recent race is added to the past performance file. Listing 7 shows this updating process for Secretariat.

That is it for the racing game. Before it can be used, however, program RACE-I (listing 13, race input) must be run to set up the file.

A 98-block file called RACE-D (or any name you choose) must be created before RACE-I is run. File RACE-D is created using the North Star disk operating system (DOS) and assigning a type 3 (the North Star code for a data file). Listing 8 shows the execution of RACE-I. This program always asks for the name of the data file first. Next, anything but a carriage return clears all of the historical data without removing the ratings and names of the horses on the file. The program execution then terminates. If a carriage return is entered now, the program enters the input/read mode. Here, horses' names and ratings can be entered, or the entire file can be read. To read the file a carriage return is entered again. Listing 8 shows the file used for the sample runs. If a return is not entered, you are in the input mode. To input, you enter an identification number between 0 and 39 (anything else ends the program), followed by a comma and the horse's name. Next you supply a class and six ratings, each separated by a comma.

The class is very important, and the number corresponds to the extra

Text continued on page 160

WHERE IS TARBELL?

ALABAMA

JACK RANDOLPH & ASSOCIATES INC
586 SHADES CREST ROAD
BIRMINGHAM 822-2339

JETT CONSULTING
1312 BROOKMEADE ST.
HUNTSVILLE 852-4364

ARIZONA

ARIZONA MICROCOMPUTER CENTER
4522 N. 19TH AVE
PHOENIX 242-2507

MICRO AGE
1425 W. 12TH PLACE SUITE 101
TEMPE 967-1421

OZYMANDIAS SYSTEMS
976 S. 5TH
YUMA 783-4315

THOUGHT WORKS
2340 N.W. GRAND SUITE 7
PHOENIX 972-4065

CALIFORNIA

AARON ENTERPRISES
PO BOX 6064 790 PINE
SAN RAFAEL 479-2473

ACTION COMPUTER ENTERPRISE
75 WEST GREEN ST. ROOM 16
PASADENA 793-2440

ADVANCED COMPUTER PRODUCTS
1310 B. EAST EDINGER
SANTA ANA 558-8813

ALPHA PROFESSIONAL SYSTEMS
8926 D. BENSON AVE
MONTCLAIR 981-8177 & 981-8188

APPLIED PROCESSOR LABORATORIES
11808 SO. PRAIRIE AVE.
HAWTHORNE 871-3232 X5249

ASTAR INTERNATIONAL COMPANY
5676 FRANCIS AVE
CHINO 284-0561

AVID ELECTRONICS
2210 BELLFLOWER BLVD.
LONG BCH. 598-0444

BELL CONTROLS
270 PROSPECT DRIVE
SAN RAFAEL 454-4782

BITS N BYTES
679 D. SO. STATE COLLEGE BLVD.
FULLERTON 879-8386

BUSINESS ENHANCEMENT COMPUSERVICE
1711 E. VALLEY PARKWAY SUITE 109
ESCONDIDO 741-6335

BYTE SHOP BURBANK
1812 W. BURBANK BLVD.
BURBANK 843-3633

BYTE SHOP
1122 B STREET
HAYWARD 537-2983

AFFORDABLE COMPUTERS
16508 HAWTHORNE BLVD
LAWNDALE 371-2421

BYTE SHOP
2233 EL CAMINO REAL
PALO ALTO 327-8080

BYTE SHOP
123 E. YORBA LINDA BLVD.
PLACENTIA 524-5380

BYTE SHOP
4 WEST MISSION
SANTA BARBARA 966-2638

AFFORDABLE COMPUTERS
3400 EL CAMINO REAL
SANTA CLARA 249-4221

BYTE SHOP
8038 CLAIREMONT MESA BLVD
SAN DIEGO 565-8008

BYTE SHOP
2707 THOUSAND OAKS BLVD.
THOUSAND OAKS 497-9595

BYTE SHOP
14300 BEACH BLVD.
WESTMINSTER 894-9131

CAL BLU CORPORATION
350 S. FIGUEROA ST. SUITE 298
LOS ANGELES 625-0673

CHERRY ELECTRONICS
23684-D EL TORO ROAD
EL TORO 5861210

RICHARD CHEW
2020 CROWN CIRCLE
LA VERNE 596-3480

COMPELEC ELECTRONICS INC
1000 W. HILLCREST BLVD
INGLEWOOD 373-5382

THE COMPUTER CENTER
8205 RONSON RD.
SAN DIEGO 292-5302

COMPUTER COMPONENTS OF ORANGE CO.
6791 WESTMINSTER AVE.
WESTMINSTER 898-8330

COMPUTER COMPONENTS INC
3808 WEST VERDUGO AVE
BURBANK 848-5521

COMPUTER COMPONENTS INC.
5848 SEPULVEDA BLVD.
VAN NUYS 786-7411+786-2199

O.I. COMPUTERS INC.
15818 HAWTHORNE BLVD
LAWNDALE 370-4842

COMPUTERLAND
4233 CONVOY ST
SAN DIEGO 560-9912

COMPUTERLAND CORP.
14400 CATALINA ST.
SAN LEANDRO 895-9363

COMPUTERLAND OF WALNUT CREEK
1815 YGNACIO VALLEY RD
WALNUT CREEK 935-6502

COMPUTER METRICS INC.
1251 BROADWAY
EL CAJON 579-8066

COMPUTER STOP
16919 HAWTHORNE BLVD.
LAWNDALE 371-4010

COMPUTER STORE OF SAN LEANDRO
701 MACARTHUR BLVD
SAN LEANDRO 569-4174

THE COMPUTER STORE
820 BROADWAY
SANTA MONICA 451-0713

COMPUTER SYS & APPLICATIONS
P.O. BOX 3243
ORANGE 632-1226

COMPUTREND
2521 W. LA PALMA
ANAHEIM 533-3572

CYBERNITIC DATA SYSTEMS
1618 INGLIS LANE
SAN JOSE 925-6354

DCI COMPUTER SYSTEMS
4670 N. EL CAPITAN
FRESNO 266-9566

DEANS MUSIC CITY
82-704 MILES AVE.
INDIO 347-5245

DELTA PRODUCTS
1653 E. 28TH
SIGNAL HILL 595-7506

DIGITAL DELI
80 WEST EL CAMINO REAL
MOUNTAIN VIEW 961-2670

DYNATRON INTERNATIONAL COMPANY
18210 SHERMAN WAY
RESEDA 881-8700

ELECTRIC BRAIN
3038 NO. CEDAR AVE.
FRESNO 227-8479

ELECTROLABS
930 EMERSON AVE
PALO ALTO 321-5605

CRAIG ERICSSON
438 N. CYPRESS
GLENDALE 243-6251

ELECTRONIC SUPPLY
2486 3RD ST
RIVERSIDE 787-9220

EVERGREEN BUSINESS SERVICES
3365 B S. WHITE ROAD
SAN JOSE 274-8717

FORMULA INTERNATIONAL
12603 CRENSHAW BLVD
HAWTHORNE 973-1921

FRANKLIN SYSTEMS CORP
733 LAKEFIELD RD
WESTLAKE VILLAGE 496-1878

FUTRA CO.
3447 TORRANCE BLVD
TORRANCE 371-8138

HOBBYWORLD ELECTRONICS
19511 BUSINESS CENTER DR
NORTHRIDGE 886-9200

HOLLYWOOD SYSTEMS
9100 SUNSET BLVD SUITE 112
HOLLYWOOD 271-9726

INDUSTRIAL MICROSYSTEMS
628 ECKHOFF ST
ORANGE 633-0355

INTERNATIONAL SCIENTIFIC USA INC
1310 E. EDINGER SUITE F
SANTA ANA 834-9100

JADE COMPUTER PRODUCTS
13440 S. HAWTHORNE BLVD
HAWTHORNE 973-7330

KHALSA COMPUTER SYSTEMS INC
500 S. LAKE AVE.
PASADENA 684-3311

LANTOR INC
7742 REDLANDS ST. SUITE H 3021
PLAYA DEL REY 821-0642

L. ELECTRONICS
410 BELL AVE.
SANTA ANA 593-4155

L.S. ENGINEERING
6701 DESOTO AVE #213
CANOGA PARK 992-1827

MICROBYTE COMPUTER STORE
2626 UNION AVE
SAN JOSE 377-4685

MICRO BUSINESS SYSTEMS INC
4563 MARMION WAY
LOS ANGELES 257-4444

MICROCOMPUTER BUSINESS SYSTEMS
2094 B. WALSH AVE
SANTA CLARA 988-3059

MICROCOMPUTER CENTER
1211 SOUTH WESTERN AVE
ANAHEIM 527-5260

MICRO DA SYS
P.O. BOX 36051
LOS ANGELES 935-4555

BROWN DOG ENGINEERING
BOX 427
LOMITA 326-8482

MICROSUN COMPUTER CENTER
2989 N. MAIN ST.
WALNUT CREEK 933-6252

M C COMPUTERS
2008 WILSHIRE BLVD
SANTA MONICA 535-3006

SUPPORT SYSTEMS
2746 BENTON ST.
SANTA CLARA 247-0638

NEW HORIZONS
1618 BEACH BLVD #172
HUNTINGTON BEACH 926-8535

ORANGE COUNTY COMPUTER CENTER
1913 HARBOR BLVD.
COSTA MESA 646-0221

PCE ELECTRONICS
4782 DEWEY DRIVE
FAIR OAKS 966-2208

PRECISION COMPUTER SYSTEMS
1737 N. 1ST SUITE 580
SAN JOSE 279-8228

PROFESSIONAL DATA SYSTEMS
318 E. 18TH ST.
BAKERSFIELD 323-0891

SAS COMPUTER PRODUCTS INC
13766 SUNSET BLVD
PACIFIC PALISADES 459-5674

SUNNY SOUNDS
927-B EAST LAS TUNAS DR.
SAN GABRIEL 287-1811

SUNSHINE COMPUTER CO.
20710 S. LEAPWOOD AVE.
CARSON 327-2118

TECH-MART
19590 VENTURA BLVD.
TARZANA 344-0153

COLORADO

BYTE SHOP
3101 WALNUT STREET
BOULDER 444-6550

BYTE SHOP
3464 SOUTH ACOMA ST.
ENGLEWOOD 761-6232

COMPUTER TECHNOLOGY
6311 N. FEDERAL BLVD.
DENVER 427-4438

CONNECTICUT

OFFICE SERVICES OF HAMDEN INC.
965 DIXWELL AVE.
HAMDEN 624-9917

DELAWARE

DELAWARE MICROSYSTEMS
2535 DARTMOUTH WOODS RD.
WILMINGTON 738-3700

FLORIDA

APPLIED MICROCOMPUTER TECHNOLOGY
241 OLD DIRT ROAD
TALLAHASSEE 878-3385

DATA TECHNOLOGY ASSOCIATES INC
10445 S.W. 70TH AVE.
MIAMI 667-3410

DELTA ELECTRONICS INC.
2000 U.S. HIWAY 441 EAST
LEESBURG 728-2478

DIGITAL MICROCOMPUTER SYSTEMS
927 BLANDING BLVD #4
ORANGEPARK 269-2002

MICROCOMPUTER TECHNOLOGY INC
1549 W. BRANDON BLVD
BRANDON 685-6714

GEORGIA

ADVANCED COMPUTER TECHNOLOGY
290 HILDEBRAND N.E.
ATLANTA 252-1094

ELECTROMAGNETIC SCIENCES INC
125 TECHNOLOGY PARK
NORCROSS 448-5770

HAWAII

MAHALO MICROSYSTEMS LTD.
355 ROYAL HAWAIIAN AVE
HONOLULU 922-2152

SMALL COMPUTER SYSTEMS
3140 WAIALAE AVE
HONOLULU 732-5246

ILLINOIS

BITS AND BYTES COMPUTER STORE
PO BOX G/292B W. 147TH ST.
POSEN 389-7112

CHAMPAIGN COMPUTER CO.
406 ELM ST.
MAHOMET 586-4131

RIES SYS. INC.
7037 WEST NORTH AVE
OAK PARK 386-3323

LILLIPUTE COMPUTER MART
4446 OAKTON ST.
SKOKIE 674-1383

MIDWEST MICROCOMPUTERS INC
708 S. MAIN ST.
LOMBARD 495-9889

WILCOX ENTERPRISES
25 W. 178 39TH ST
NAPERVILLE 420-8601

INDIANA

DIGITAL TECHNOLOGY
10 N 3RD
LAFAYETTE 423-2548

DATA DOMAIN
221 WEST DODDS
BLOOMINGTON 334-3607

DIGITAL SUPPLY
817 AGATHON DR.
EVANSVILLE

THE HOME COMPUTER CENTER
2115 EAST 62ND ST.
INDIANAPOLIS 251-6800

SMITH COMPUTER SYSTEMS
530 PIERCE AVE.
DYER 322-5461

KANSAS

COMPUTER CENTER
5815 JOHNSON DRIVE
MISSION 432-BYTE

COMPUTER SYSTEM DESIGN
906 N. MAIN
WICHITA 265-1120

LOUISIANA

GREAT SOUTHERN COMPUTER SYSTEMS
915 TALBOT
THIBODAUX 446-8432

BILL GULLEDGE
ROUTE 1 BOX 264-A
DONNSVILLE 982-5610

MARYLAND

COMPUTERS ETC.
13A ALLEGHENY AVE.
TOWSON 296-0520

MASSACHUSETTS

THE COMPUTER MART INC
1395 MAIN ST ROUTE 117 AT 128
WALTHAM 899-4540

COMPUTER SHOP
288 NORFOLK ST.
CAMBRIDGE 661-2670

SCIENTIFIC CONSULTING SERVICES
35 LINDA AVE
FRAMINGHAM 926-4046

MICHIGAN

AMERICAN COMPUTER CENTER INC.
1800 WEST FOURTEEN MILE RD.
ROYAL OAK 576-0900

COMPUTER STORE OF DETROIT
4132 N. WOODWARD
ROYAL OAK 549-2870

GAN COMPUTERTRONICS
37727 AMRHEIN RD.
LIVONIA 464-0441

JRPSAN
GROUP K 4706 MORNINGSIDE DR. S.E.
GRAND RAPIDS 241-8336

UNITED MICROSYSTEMS CORP.
2601 S. STATE ST.
ANN ARBOR 668-6806

MINNESOTA

AGRI-ELECTRONICS INC
1061 E. CLIFF ROAD
BURNSVILLE 890-0040

BROM MICROSYSTEMS ENGINEERING INC
3655 W. 6TH ST.
WINONA 452-7958

COMMERCIAL COMPUTER INC.
2200 W. 94TH AVE
MINNEAPOLIS 884-8003

COMPUTER DEPOT INC
7625 BUSHLAKE RD
MINNEAPOLIS 831-2088

MINNESOTA MICROSYSTEMS
514 CEDAR AVE
MINNEAPOLIS 338-5604

MISSISSIPPI

OXFORD SOFTWARE COMPANY
1125 JACKSON AVE
OXFORD 234-2226

MONTANA

CLIVUS MULTRUM
205 MEADOW ROAD
WHITEFISH 862-3854

NEBRASKA

OMAHA COMPUTER STORE
4540 S. 84TH ST.
OMAHA 592-3590

NEW JERSEY

CBS CONSOLIDATED
264 MALAPARDIS RD
MORRIS PLAINS 267-2653

COMPUTER EMPORIUM
BLDG 103 AVENUES OF COMMERCE
CHERRY HILL 667-7555

COMPUTER LAB OF NJ
141 ROUTE 46
BUDD LAKE 691-1984

COMPUTER MART OF NJ INC.
501 ROUTE 27
ISELIN 283-0600

COMPUTER SYSTEMS INTERNATIONAL
539 DURIE AVE
CLOSTER 767-7510

ELECTRO ANALYTIC SYSTEMS INC
448 RT 15 SOUTH
WHARTON 361-4300

S-100 INC.
7 WHITE PL.
CLARK 382-1318

NEW YORK

BYTE SHOP EAST
2721 HEMPSTEAD TRKE.
LEVITOWN 731-8116

COMPUTER SHOP OF SYRACUSE INC
3470 ERIE BLVD EAST
DEWITT 637-6208

COMPUTER MICROSYSTEMS
1311 NORTHERN BLVD.
MANHASSET 627-3640

MANAGEMENT COMPUTER SYSTEMS
86-16 SANTIAGO ST.
HOLLIS 479-7783

MINI MICRO MART
1618 JAMES
SYRACUSE 422-4467

OWENS ASSOCIATES
12 SCHUBERT ST
STATEN ISLAND 448-6283

NORTH CAROLINA

ALPHA DIGITAL SYSTEMS INC.
RT. 4 BOX 171 A
BOONE 264-7946

BYTE SHOP OF RALEIGH
1213 HILLSBOROUGH ST.
RALEIGH 833-0210

COMPUTER SHARING INC.
273 HAYWOOD ST.
ASHVILLE 253-2364

SOUTHERN DIGITAL SYSTEMS INC
VERNON PARK MALL SUITE 806A
KINSTON 527-4691

OHIO

CINCINNATI COMPUTER STORE
4816 INTERSTATE DR.
CINCINNATI 874-0600

COMPUTERLAND OF CLEVELAND
1288 SOM CENTER ROAD
MAYFIELD HEIGHTS 461-1200

COMPUTER MART
6310 LINWORTH ROAD
COLUMBUS 846-2966

DIGITAL AUTOMATION ASSOCIATES INC
735 HASKINS RD
BOWLING GREEN 352-6977

MIDWEST MICROCOMPUTERS
1671 TIMMY
HAMILTON 874-0600

OHIO MICROCOMPUTER SPECIALIST
1265 GRANDVIEW AVE
COLUMBUS 488-1849

QUASAR DATA PRODUCTS
3501 LAKEVIEW BLVD
STOW 779-9387

TEC MAR INC.
23414 GREENLAWN AVE.
BEECHWOOD 382-7599

OKLAHOMA

MICROLITHICS INC.
2918 N. MACARTHUR BLVD
OKLAHOMA CITY 947-5646

OREGON

BYTE SHOP BEAVERTON
3482 S.W. CEDAR HILLS BLVD.
BEAVERTON 223-3496

COMPUTERLAND OF PORTLAND
12020 S. WEST MAIN
TIGARD 642-3212

THE REAL OREGON COMPUTER CO. INC.
205 WEST TENTH ST.
EUGENE 484-1040

PENNSYLVANIA

ERIE COMPUTER COMPANY
1253 W. 8TH ST.
ERIE 454-7652

MARKETLINE SYSTEMS INC.
2337 PHILMONT AVE
HUNTINGDON VALLEY

SOUTH CAROLINA

BRK ELECTRONICS INC.
1811 HUNTINGTON PLACE
ROCK HILL 366-1329

THE BYTE SHOP 32
2018 GREEN ST.
COLUMBIA 771-7824

SOUTH DAKOTA

HAL CORPORATION
1425 COMET RD
SIOUX FALLS 332-4828

TENNESSEE

COMPUTER WORLD
625 MAIN ST.
NASHVILLE 255-8330

EASTERN MICROCOMPUTER STORES INC.
5613 KINGSTON PIKE
KNOXVILLE 584-8365

HOMESTEAD TECHNOLOGIES CORPORATION
2114 WEST END AVE
NASHVILLE 320-1883

TEXAS

ANDY ELECTRONICS CO. INC.
6319 LONG DRIVE
HOUSTON 641-0576

AUSTIN MICROPRODUCTS
C/O DAN DRUMMOND RT 3 BOX 87A
ROCKDALE 446-2248

COMPUTER MART OF WEST TEXAS
4622 28TH ST.
LUBBOCK 797-7550

THE COMPUTER STORE
3411 MARQUART SUITE 102
HOUSTON 522-7845

ELECTRONIC SPECIALTY CO.
4032 BELLAIRE BLVD.
HOUSTON 665-0477

HOUSTON COMPUTER MART
8029 GULF FREEWAY
HOUSTON 649-4188

INTEGRATED DATA SYSTEMS
6002 CERRITOS
HOUSTON 729-9160

MICROBYTE ABACUS
2212 CRAWFORD
HOUSTON 757-1128

THE MICRO STORE
634 S. CENTRAL EXPRESSWAY
RICHARDSON 231-1096

MICROSYSTEMS SERVICES INC.
5301 EVERHART SPACE H
CORPUS CHRISTI 855-4516

MICROTRONICS INC
P.O. BOX 985
DICKINSON 337-5112

RADIO HUT
201 LOCKWOOD
DALLAS 324-2829

RIBIGITAL ELECTRONIC CO
1423 WEST TERRELL ST
FORT WORTH 336-0777

THE K.A. COMPUTER STORE
9090 STEMMONS FWY
DALLAS 643-2667

YOUNG ELECTRONIC SERVICE
808 F. BROTHER'S BLVD
COLLEGE STATION 693-3462

UTAH

ARRON COMPUTER SERVICE
4154 S. 300 WEST
SALT LAKE CITY 268-0130

COMPUTERS + STUFF OF UTAH
1717 WEST CENTER ST.
PROVO 377-1717

VIRGINIA

COMPUTER PLUS
6120 FRANCONIA RD
ALEXANDRIA 751-1115

COMPUTER SYSTEMS STORE
1984 CHAIN BRIDGE RD.
MCLEAN 821-8333+821-8334

THE HOME COMPUTER CENTER
12588 WARWICK BLVD.
NEWPORT NEWS 827-3917

WASHINGTON

INNOVATIVE COMPUTING INC.
1135 LAKE ST. SOUTH SUITE 245
KIRKLAND 827-0731

NORTHWEST DATACOMM
13400 NORTHUP WAY SUITE 19
BELLEVUE 641-0882

OLYMPIC COMPUTERS
418 S. LINCOLN
PORT ANGELES 457-3315

WEST VIRGINIA

THE COMPUTER CORNER INC
22 BEECHURST AVE
MORGANTOWN 293-5121

MORRIS ENTERPRISES
1 MAIN ST
OSAGE 599-5121

WISCONSIN

BYTE SHOP OF MILWAUKEE
6019 W. LAYTON AVE
GREENFIELD 278-6000

DNA INC.
545 MEADOW LN.
SHEBOYGAN FALLS 467-6006

MAGIC LANTERN COMPUTERS
3313 UNIVERSITY AVE
MADISON 233-2026

OUTSIDE U.S.

BYTRONIX MICROCOMPUTER LTD
83 WEST STREET
FARNHAM SURREY
GU97 N. ENGLAND

CANADIAN MICROCOMPUTER SYSTEMS
PO BOX 1154
BRANDON
MANITOBA CANADA R7A 6A5

COMPUTER CENTRE
9 DE-LA-BECHE STREET
SWANSEA
SOUTH WALES SA1 3EX
0792 460023

MICROBOARDS
1-7-1-1003 SAIWAI - CHO
CHIBA CITY
JAPAN 260
47 0427 (47) 3081

ORTHON COMPUTERS
12411 STONY PLAIN ROAD
EDMONTON - ALBERTA
CANADA T5N 3N3
403 448-2921

PAUL SCHENKER
PO BOX 176
ZURICH
SWITZERLAND 8044
213 473-3747

Listing 6: *RACE program execution, but this time with more historical data. Then a request for SECRETARIAT'S statistics is made.*

```
RANDOM NUM ? 43
# OF HORSES ? 40
FILE: RACE-D

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1          1807

ID NAME         R#  1  2  3      $ WON ID NAME         R#  1  2  3      $ WON
==============================================================================
 0 BUCKPASSER   4  2  0  0  $82150. 20 RABBIT-----  0  0  0  0        $0.
 1 DAMASCUS---  3  1  0  1  $28650. 21 COL. BAY---  0  0  0  0        $0.
 2 DR FAGER---  5  1  0  1  $16900. 22 THE GEN----  0  0  0  0        $0.
 3 RIVA RIDGE   8  1  0  1  $18700. 23 THE ONE----  0  0  0  0        $0.
 4 SUE'S GIRL  10  0  0  0      $0. 24 ALL BUT ON   0  0  0  0        $0.
 5 FOREGO----- 10  0  4  2  $48300. 25 CAN DO-----  0  0  0  0        $0.
 6 SECRETARIT  10  1  2  2  $38700. 26 DON'T SAY-   0  0  0  0        $0.
 7 FOOLISH PL  10  0  2  0  $11300. 27 PERSONALIT   0  0  0  0        $0.
 8 RUFFIAN----  7  2  0  0  $86450. 28 RUFF & RED   0  0  0  0        $0.
 9 BOLD RULER   5  1  0  1  $31450. 29 ----------  0  0  0  0        $0.
10 GALLANT MA   9  0  2  2  $34350. 30 ----------  0  0  0  0        $0.
11 ROUND TABL   9  1  0  0  $16050. 31 ----------  0  0  0  0        $0.
12 TIM TAM----  0  0  0  0      $0. 32 ----------  0  0  0  0        $0.
13 SWORD DANC   0  0  0  0      $0. 33 ----------  0  0  0  0        $0.
14 KELSO------  0  0  0  0      $0. 34 ----------  0  0  0  0        $0.
15 CARRY BACK   0  0  0  0      $0. 35 ----------  0  0  0  0        $0.
16 CICADO-----  0  0  0  0      $0. 36 ----------  0  0  0  0        $0.
17 NORTHERN D   0  0  0  0      $0. 37 ----------  0  0  0  0        $0.
18 MAN O'WAR-   0  0  0  0      $0. 38 ----------  0  0  0  0        $0.
19 SILKY SULL   0  0  0  0      $0. 39 ----------  0  0  0  0        $0.
READY TO RETURN ?

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 2          1750

ID# ? 6
SECRETARIT 10 1 2 2 38700
DAY RACE T        PURSE-#H DIS    TIME WGH  P  S  H  S  F  L   TIME   ODDS WINNER
==================================================================================
  9 STAKES   $103000.-12 12F 2:24.4 120  4  5 11 11  9  5 2:25.4   4.60 RUFFIAN-
  8 ALLOW.    $85000.-12  6F 1: 7.3 120  5 11 10 10 10  5 1: 8.3   4.40 BUCKPASS
  7 CONDIT.   $30000.- 6 10F 1:59.3 120  1  2  1  4  1  0 1:59.3   1.60 SECRETAR
  6 MAIDEN    $20000.- 6  6F 1: 7.4 120  1  2  2  2  3  2 1: 8.1   1.60 ROUND TA
  5 MAIDEN    $24000.- 7  8F 1:33.1 120  1  4  1  3  4  4 1:34.0   2.40 RIVA RID
  4 MAIDEN    $30000.- 8  9F 1:46.3 120  1  6  4  7  6  4 1:47.1   3.00 RUFFIAN-
  3 MAIDEN    $31000.- 9  8F 1:33.4 120  1  5  7  8  8  8 1:35.2   3.60 BOLD RUL
  2 HANDICAP  $20000.-10  7F 1:20.3 121 10  7  7  3  3  2 1:21.0  10.80 DR FAGER
  1 MAIDEN    $39000.-11  6F 1: 7.3 120  1  6  4  4  2  0 1: 7.3   4.20 BUCKPASS
  0 MAIDEN    $31000.- 9  8F 1:33.2 120  3  6  4  2  2  0 1:33.2   4.00 DAMASCUS
```

Listing 7: *Updating the file on SECRETARIAT. The least current race is dropped from the record and the most recent race is added to the past performance file.*

```
ID# ? 6
SECRETARIT 11 1 2 2 38700
DAY RACE T       PURSE-#H DIS    TIME WGH  P  S  H  S  F  L  TIME    ODDS WINNER
================================================================================
 11 ALLOW.    $51000.-10  6F 1: 8.1 123 10  2  6  6  6  6 1: 9.2   2.00 DON'T SA
  9 STAKES   $103000.-12 12F 2:24.4 120  4  5 11 11  9  5 2:25.4   4.60 RUFFIAN-
  8 ALLOW.    $85000.-12  6F 1: 7.3 120  5 11 10 10 10  5 1: 8.3   4.40 BUCKPASS
  7 CONDIT.   $30000.- 6 10F 1:59.3 120  1  2  1  4  1  0 1:59.3   1.60 SECRETAR
  6 MAIDEN    $20000.- 6  6F 1: 7.4 120  1  2  2  2  3  2 1: 8.1   1.60 ROUND TA
  5 MAIDEN    $24000.- 7  8F 1:33.1 120  1  4  1  3  4  4 1:34.0   2.40 RIVA RID
  4 MAIDEN    $30000.- 8  9F 1:46.3 120  1  6  4  7  6  4 1:47.1   3.00 RUFFIAN-
  3 MAIDEN    $31000.- 9  8F 1:33.4 120  1  5  7  8  8  8 1:35.2   3.60 BOLD RUL
  2 HANDICAP  $20000.-10  7F 1:20.3 121 10  7  7  3  3  2 1:21.0  10.80 DR FAGER
  1 MAIDEN    $39000.-11  6F 1: 7.3 120  1  6  4  4  2  0 1: 7.3   4.20 BUCKPASS
```

Text continued from page 156:

lengths added to each one of the six ratings. The ratings are numbers between 1 and 13. The higher the rating, the faster the horse runs. The first rating sets the speed of the horse for the first two furlongs of a race; the second rating sets how fast the third and fourth furlongs are run, etc. Therefore, for a six-furlong race, only class and ratings 1, 2 and 3 are used. An eleven or twelve-furlong race utilizes class and all six ratings.

If you have a North Star disk, you are ready to simulate horse racing. If not, the following discussion will show you how to eliminate the files and reduce memory requirements.

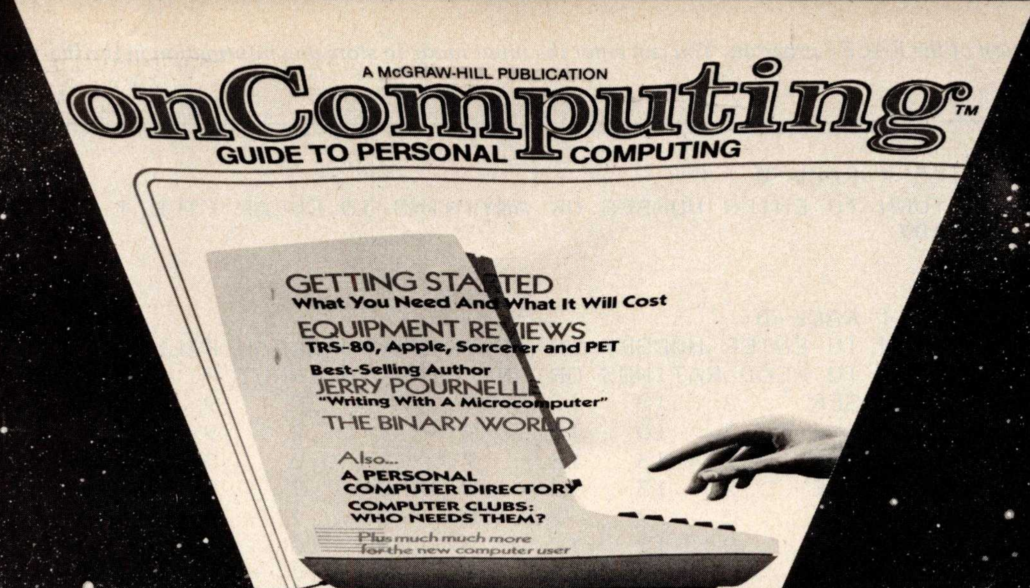
File Structure

Before the file structure and the time requirements to manipulate files are discussed, program RACE will be described. Table 1 shows the key variables and functions by line numbers. As can be seen, almost everything is a subroutine. If you decide to remove a subroutine to save memory, I suggest reentering the first line of each routine to be eliminated as a RETURN, and deleting all other lines. This saves you from the task of looking for all references to the deleted subroutine. After eliminating a subroutine, testing will have to be done to ensure that variables still conform to print formats.

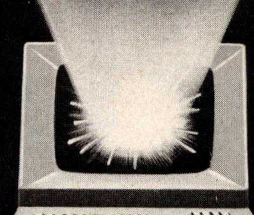
In listing 1, the program RACE was run with only twelve horses, and about 16,030 bytes of memory were required. With a forty-horse race (listing 6), 17,949 bytes are needed. In listing 9, I edited the program quickly to eliminate all file references. This version was run with only two horses and required only 11,917 bytes of memory. More memory can be saved by eliminating other subroutines.

This edited version of RACE does not require the use of program RACE-I, since all horses' names, classes and ratings are now data statements (listing 9 lines 1000 and 1001). You will notice, however, that the ratings are no longer numbers between 1 and 13. Program RACE-I converted the ratings 1 to 13 to the numbers shown in lines 1000 and 1001 of listing 9. If you examine lines 20 and 30 of listing 13, RACE-I, you can see the thirteen numbers into

Text continued on page 164



When will the Personal Computer Explosion touch YOU?



Are you prepared for the explosive transformation? Right in your own home? Electronic mail. Personalized investment analysis. Foreign language tutorial. Home energy management. Robots. Computer music. Secretarial service. Diet and menu planning. And more, more, more.

onComputing,™ the new McGraw-Hill quarterly, prepares you for the enormous changes coming during the 1980's (Some are already here). **onComputing™** explains in nontechnical language what personal computers are, how they work, and how you can use them at home, for fun and profit.

Don't let the personal computer explosion catch you off guard. Know what's happening and help make it happen! Prepare now for the exciting future with a subscription to **onComputing™**!

Call Toll-Free
800-258-5485

Start your subscription today.

onComputing™ Subscription Dept. P.O. Box 307, Martinsville, NJ 08836

DOMESTIC subscription rate:
☐ U.S. 1 yr. (4 issues) @ $8.50 ☐ Canada & Mexico, 1 yr. (4 issues) @ $10.00
FOREIGN (to expedite service, please remit in U.S. funds drawn on a U.S. bank.)
☐ Europe (and all other countries, except above), 1 yr. @ $12.00 — surface delivery.

☐ Bill Visa ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number ______ Expiration ______

Signature ______ Name (please print) ______

Street/Apartment Number ______

City ______ State/Province/Country Code ______

Please allow 6-8 weeks for processing.

Listing 8: *Execution of the RACE-I program. You can enter the input mode to store any information in the file. Here we chose just to read the file.*

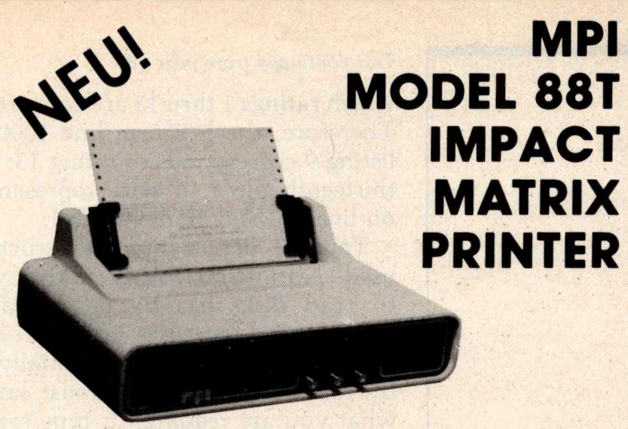
```
FILE : RACE-D
RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ? CLEAR
READY
RUN

FILE : RACE-D
RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ?
RETURN TO READ RATINGS OR ANYTHING TO INPUT ?
BUCKPASSER     2   12   12    9    9    9    9
DAMASCUS--     2   10   10    9    9    9    9
DR FAGER--     2   13   13    9    9    5    5
RIVA RIDGE     2   13   13    8    8    9    9
SUE'S GIRL     2    7    7    8    8    7    7
FOREGO----     2   12   12    9    9   10   10
SECRETARIT     2   13   13    9    9   10   10
FOOLISH PL     2    9    9    8    8    7    7
RUFFIAN---     2   13   13    8    8    7    7
BOLD RULER     2   12   12    9    9    5    5
GALLANT MA     2   10   10    9    9   10   10
ROUND TABL     2   10   10    9    9    8    8
TIM TAM---     2    9    9    9    9    9    9
SWORD DANC     2    9    9    8    8    9    9
KELSO-----     2   10   10    9    9   10   10
CARRY BACK     2    8    8    9    9    5    5
CICADO----     2    7    7    7    7    6    6
NORTHERN D     2   10   10    8    8    5    5
MAN O'WAR-     2   13   13    9    9   10   10
SILKY SULL     3    1    1   13   13   13   13
RABBIT----     2   13   13    1    1    1    1
COL. BAY--     0   13   12   11   10    9    8
THE GEN---     1   13   13   13    1    1    1
THE ONE---     0    1   13   13   13   13   13
ALL BUT ON     1    1    1   13   13    1    1
CAN DO----     1    2    2    6    6   10   10
DON'T SAY-     0    7    7    7    7    7    7
PERSONALIT     0    7    7    7    7    7    7
RUFF & RED     1    7    7    7    7    7    7
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
----------     0    0    0    0    0    0    0
READY
RUN

FILE : RACE-D
RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ?
RETURN TO READ RATINGS OR ANYTHING TO INPUT ? INPUT
ID, NAME ? 29,NAME IT
CLASS AND 6 RATINGS ? 0,12,12,6,6,6,6
RETURN TO READ RATINGS OR ANYTHING TO INPUT ? INPUT
ID, NAME ? 99,
READY
```

NEU!

MPI MODEL 88T IMPACT MATRIX PRINTER



The first of a series of new, full-capability, low cost, high performance printers designed by MPI to meet the requirements of the general use computer market – hobbyist or professional.

SPECIFICATIONS

- Impact Bidirectional
- 7×7 Dot Matrix
- 100 Characters Per Second
- 80, 96 and 132 Column
- 10 Lines Per Second
- Tractor and Friction Feed
- Normal Paper: Roll, Fan-fold or Cut Sheets
- 115/230 VAC ±10%, 50/60 Hz
- 96 ASCII Upper and Lower
- RS232C; 20 ma. Current Loop
- 110-1200 BAUD
- 2 Line Buffer; 1 or 2 K Optional
- Centronics Parallel
- 41×27×16 cm; 7 Kg.

Sigma International, Inc. is master international distributor for **MPI** and seeks dealers/distributors worldwide. Please write us on your letterhead at the following address:

SIGMA INTERNATIONAL, INC.
P.O.Box 1118 SCOTTSDALE, AZ 85252 USA
Tel. (602) 994-3435 Tlx. 165-745 Sigma Cable: SIGMAS

MICROCOMPUTERHÄNDLER

WIR LADEN EIN!

Handeln Sie als Wiederverkäufer mit Microcomputer-systemen und Peripheriegeräten und sehen sich daher gezwungen, mit den immer noch überhöhten Preisen Ihrer jetzigen Lieferanten zu kalkulieren? Dann wählen Sie doch den einfacheren Weg und beziehen direkt aus den USA!

Sigma ist weltweiter Lieferant führender amerikanischer Hersteller und offeriert Preise und Service, wie sie Ihnen keine andere Quelle bieten kann.

Unter anderem verkaufen wir Geräte der Firmen:

Base 2	Impact Data	North Star
Centronics	Industrial Micro	Ohio Scientific
Century Data	Integral Data	PerSci
Control Data	Konan	Qume
Exidy	LRC Eaton	Soroc
Hazeltine	Micro Peripherals	Televideo
Houston Inst.	N.E.C.	Texas Instruments

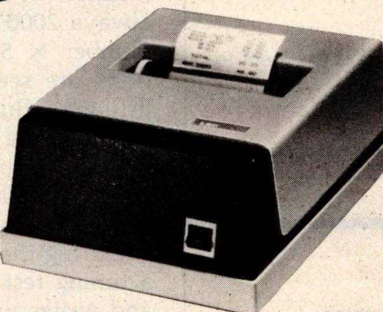
Wir laden Sie daher ein, kostenlos unsere neueste Preisliste anzufordern, und Sie werden feststellen, dass Sie wesentlich günstiger kaufen können. Bitte schreiben Sie – auf Kopfbogen – an folgende Adresse:

Σ Sigma INTERNATIONAL

SIGMA INTERNATIONAL, INC.
P.O.Box 1118 SCOTTSDALE, AZ 85252 USA
Tel. (602) 994-3435 Tlx. 165-745 Sigma Cable: SIGMAS

NEW

LRC EATON MODEL 7000+ IMPACT PRINTER



- Simple Design
- Simple Maintenance
- Simple Interfacing to:
  - Apple
  - Pet
  - TRS-80
  - Exidy
  - OSI

  and many other personal computers

The 7000+ was designed to provide the personal computer user with an inexpensive, yet reliable printer. Take a look – you won't regret it!

SPECIFICATIONS

- Impact Unidirectional
- 1.25 LPS; 50 CPS
- 40 or 64 Column
- 5 × 7 Dot Matrix
- Standard Paper Rolls
- 100 Million Character Printhead Life (minimum)
- 6 LPI Line Spacing

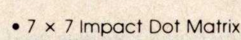
Substantial Dealer Discounts are Available.

OEM inquiries are invited. Please contact:

SIGMA INTERNATIONAL, INC.
P.O. Box 1118 SCOTTSDALE, AZ 85252 USA
Tel. (602) 994-3435 Tlx. 165-745 Sigma Cable: SIGMAS

IMPACT DATA MODEL 801

THE HEAVY DUTY WORKHORSE AT THE AFFORDABLE PRICE.



- 7 × 7 Impact Dot Matrix
- 132 CPS (max.)
- 96 Character Upper/Lower ASCII
- 8.0 in. (20.3 cm) Line Length
- 80 or 96 Columns
- 6 LPI Line Spacing
- Tractor or Friction Feed
- 127 Character Buffer – 2 K Optional
- Feed at 50 LPM Printing – 560 LPM Slewing
- Continuous Loop Ribbon with Re-inking Roller – 5 Million Character Life
- Paper is Standard Fan-fold, Multi-copy Computer Forms up to 9-5/8" (24.45 cm)
- 8-bit Parallel (Centronics Compatible), RS232 or 20 ma. Current Loop Interfaces, 110/1200 BAUD, Switch Selectable
- 115 VAC, 3A, 60 Hz. or 220 VAC, 1.5A, 50 Hz.
- 12"H × 18"W × 14"D (30 × 45 × 35 cm)

High Quality • High Technology • Low Price

Substantial Dealer/Distributor Discounts Available

SIGMA INTERNATIONAL, INC.
P.O. Box 1118 SCOTTSDALE, AZ 85252 USA
Tel. (602) 994-3435 Tlx. 165-745 Sigma Cable: SIGMAS

Circle 92 on inquiry card.

Key Variables

T$(864)	represent the track displayed
T1$(54)	54 blanks used in printing of the track's center
T3$(60)	60 blanks used to set track
N$(12)	the 12 horses' post positions for printing the track
M(12,6,4)	12 = the 12 horses that can be in a race
	6 = the 6 individual ratings
	4 = each rating broken into 5 possibilities
O(12)	the odds of each horse winning
H(U,11)	U = number of horses in the run
	11 = 0 class
	1-6 ratings
	7 races run
	8 firsts
	9 seconds
	10 thirds
	11 earnings
H$(A)	horses' names
R(99,3)	99 represents the 100 races
	3 = 0 type/distance/# horses
	1 purse
	2 winning time
	3 race winner
R$(48)	types of races
A(12,9)	12 = twelve horses
	9 = 0 ID of horse
	1 weight
	2 location of horse
	3 what lane horse is in
	4-7 position at the start, half, stretch, finish
	8 length behind or ahead
	9 time

Functions by Line Number (S = subroutine)

1 thru 35	Set variables and request historical file name
40 thru 65	Read historical file
70 thru 90	Select action code
5000 thru 5040S	Prints list of horses
6000 thru 6099S	Prints statistics (past performances)
7000 thru 7290S	Runs race
7300 thru 7360S	Prints results of race
7900 thru 7920S	Set what parts of each race will be placed in at the "start, half, stretch"
8000 thru 8040S	Clears track
8100 thru 8140S	Prints prerace list of horses with odds
8200 thru 8260S	Automatic selection of horses to be included in a race
9000 thru 9195S	Prints track
9300 thru 9350S	Sets the odds
9400 thru 9440S	Sets weights for allowance and handicap races
9500 thru 9530S	Calculates win, place, and show payoffs
9600 thru 9601S	Calculates times
9700 thru 9710S	Updates summary records
9800 thru 9825S	Updates individual records
9900 thru 9910S	Updates general race file to indicate what data is pertinent to each race date
9950 thru 9995	Writes all data to files and ends program

Table 1: *List of all key variables and functional routines used in the RACE program.*

File Structure

Type Code	Number of Records	x	Size of 1 Record	=	Total Bytes	Contains
1	100		20		2000	History of each racing date: variable R(99,3)
2	40		72		2880	Summary of historical data for each horse: variable H(U,11)
3	400		50		20000	Detail history of last 10 races run by each horse
	540		142		24880	or 98 blocks of 256 bytes

Organization of File

100 type 1 records

followed by 40 groupings of 1 type 2 record and 10 type 3 records

Table 2: *Detailed description of the file structure used to implement the horse race simulation.*

Text continued from page 160:

which ratings 1 thru 13 are converted. Therefore, the 51555 in line 1000 of listing 9 corresponds to rating 13: the thirteenth piece of data represented on lines 20 and 30 of RACE-I.

Table 2 details the file structure used. North Star BASIC allows you to read disk files by bit location. Records can therefore be of varying sizes and can be read sequentially or by random access. You must know what you are reading, or type errors (reading a string variable into a non-string variable or vice versa) will occur and terminate the program.

In program RACE, the computer must always know the current race day, in order to update the proper race. This feature was added to save storage space. As detailed in table 1, variable R(99,3) carries the data common to each race, so individual past performance records for each horse need not carry this information. In order to accomplish this, an attempt is made to read the first 100 records of the file sequentially (lines 40 and 45 of listing 14, RACE program). As soon as a blank record is encountered, the read process is terminated and the computer assigns this point as the current race day.

Next, the computer reads only the summary information of the horses selected for the run. This is done by random-access read operations. The location of the summary record is always 2000 bytes + (identification number × 572 bytes). These operations are seen in lines 50 to 65 of listing 14. But why not read all information? The answer is memory limitations. Assuming a forty-horse run, an additional 20,000 bytes of memory would be required.

During the design of this program, a timing test program for disk reads and writes was developed. This was done to minimize execution times and to serve as a guide in writing future applications.

Listing 10 shows the output of this test and a sample run. The program prints its start time "7 31 37" (7 hours, 31 minutes, 37 seconds). The next time represents the time when ten new records are added to the file. The last time corresponds to when the program finishes reading the ten records five times each. These times are approximate, since the smallest

Text continued on page 172

Circle 94 on inquiry card.

Listing 9: *Section of code from the RACE program edited to eliminate all file references.*

```
LOAD RACE
READY
25
DEL 40,45
READY
EDIT 50
50 Y=A\FORA=0TO U\A1=(10*A)+1
EDIT 60
60 READ        H$(A1,A1+9),H(A,0),H(A,1),H(A,2),H(A,3),H(A,4),H(A,5)
65 READH(A,6)\NEXT
1000 DATA"FIRST DATA",1,51555,51555,51555,51555,51555,51555
EDIT 1000
1001 DATA"SECOND TRY",1,51555,51555,51555,51555,51555,51555
6000 RETURN
DEL 6010,6099
READY
7110
EDIT 8010
8010 FORZ=1TO15\T$=T3$+T$\NEXT\RETURN
DEL 8020,8140
READY
9000 RETURN
DEL 9001,9195
READY
9950 END
DEL 9960,9995
READY
RUN

RANDOM NUM ? 2
# OF HORSES ? 2

1 FOR LIST OF HORSES
2 FOR STATISTICS
3 FOR RACE
0 TO END ? 1            7839

ID NAME          R#  1   2   3     $ WON ID NAME          R#  1   2   3     $ WON
================================================================================
 0 FIRST DATA  0   0   0   0     $0.   1 SECOND TRY  0   0   0   0       $0.
READY TO RETURN ?

 1 FOR LIST OF HORSES
 2 FOR STATISTICS
 3 FOR RACE
 0 TO END ? 3            7782

TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN 5=HANDICAP 6=WORKOUT
DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12
TYPE, DISTANCE, HORSES? 6,6,2
YES FOR AUTOMATIC SELECT. ? YES
ID START & ID END SEARCH ? 0,1
POST  1  SECOND TRY
POST  2  FIRST DATA
?

ID NAME          WT   P   S   H   S   F BY   L M:SS.F      ODDS
================================================================
 0 FIRST DATA 120   2   1   2   2   1 BY   0 1: 8.0        .00
 1 SECOND TRY 120   1   2   1   1   2 BY   0 1: 8.0        .00

READY?
```

Diagnostics I for CP/M* & TRSDOS#

Someday your computer is going to break; even the most reliable computer systems "go down". Often, finding exactly what is wrong can account for the most time consuming part of repairing the system, and the longer the system is down, the more money you lose.

DIAGNOSTICS I is a complete program package designed to check every major area of your computer, detect errors, and find the cause of most common computer malfunctions, often before they become serious. For years, large installations have run daily or weekly diagnostic routines as a part of normal system maintenance and check-out procedures.

DIAGNOSTICS I is designed to provide that kind of performance testing for 8080/Z80 micro computers.

DIAGNOSTICS I will really put your system through its paces. Each test is exhaustive and thorough. The tests include:

- Memory Test
- Disk Test
- CPU Test (8080/8085/Z80)
- Printer Test
- CRT Test

To our knowledge, this is the first CPU test available for 8080/Z80 CPU's. Many times transient problems, usually blamed on bad memory, are really CPU errors.

A good set of diagnostics is an indispensable addition to your program library even if your system is working fine. Hours have been wasted trying to track down a "program bug" when actually hardware was to blame!

DIAGNOSTICS I also allows you to be confident of your system. This can be critical when file merges or sorts and backups are involved. You want to be as sure of your computer as possible during these critical times. Running DIAGNOSTICS I prior to these and other important functions helps to insure that your system is operating at peak performance.

DIAGNOSTICS I is supplied on discette with a complete users manual.

DIAGNOSTICS I: $50.00
Manual: $15.00

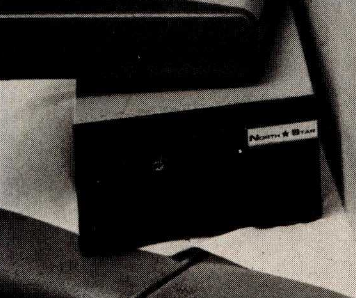
Requires: 24K CP/M; 16K disc for TRS-80
formats: CP/M 8" SOFT SECTORED, NORTHSTAR CP/M AND TRS-80 DOS

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 344-7596
Technical Hot Line: (217) 384-0847
(answered only when technician is available)

Give your computer a "physical" today!







SuperSoft
First in Software Technology

Circle 96 on inquiry card.

*CP/M REGISTERED TRADEMARK DIGITAL RESEARCH
#TRSDOS, TRS-80 TRADEMARKS TANDY CORP

Listing 10: *Listing of the timing test program for disk reads and writes.*

```
 5 DIMV(12)
 10 GOSUB 9857\!U1,U2,U3
 20 OPEN#0,"A4,2"
 30 FORA=1TO10
 40 FORB=1TO9\C=(B-1)*60
 50 READ#0%C,V(1)
 60 FORD=2TO12\READ#0,V(D)\NEXT
 70 C=C+60
 80 WRITE#0%C,V(1)
 90 FORD=2TO12\WRITE#0,V(D),NOENDMARK\NEXT\NEXT
 100 C=0\WRITE#0%C,V(1)
 110 FORD=2TO12\WRITE#0,V(D),NOENDMARK\NEXT
 120 NEXT
 130 GOSUB 9857\!U1,U2,U3
 200 FORA=1TO5
 210 FORB=0TO540STEP60
 220 READ#0%B,V(1)
 230 FORD=2TO12\READ#0,V(D)\NEXT
 240 NEXT
 245 NEXT
 250 GOSUB 9857\!U1,U2,U3
 260 !FREE(0)
 270 END
9857 FORU=0TO7\U(U)=INP(168+U)\NEXT\U1=10*U(7)+U(6)
9858 U2=10*U(5)+U(1)\U3=10*U(2)+U(3)\RETURN
READY
RUN

 7 31 37
 7 32 21
 7 32 30
 18863
READY
```

Listing 11: *Some modifications of the previous listing. The use of loops for indexing read/write variables has been eliminated and, as a result, the program execution time is reduced.*

```
LOAD A2,2
READY
LINE 80
READY
50 READ#0%C,V(1),V(2),V(3),V(4),V(5),V(6),V(7),V(8),V(9),V(10),V(11),V(12)
60
80 WRITE#0%C,V(1),V(2),V(3),V(4),V(5),V(6),V(7)
90 WRITE#0,V(8),V(9),V(10),V(11),V(12),NOENDMARK:NEXT
100 C=0:WRITE#0%C,V(1),V(2),V(3),V(4),V(5),V(6),V(7)
110 WRITE#0,V(8),V(9),V(10),V(11),V(12),NOENDMARK
220 READ#0%B,V(1),V(2),V(3),V(4),V(5),V(6),V(7),V(8),V(9),V(10),V(11),V(12)
230
RUN

 7 47 0
 7 47 37
 7 47 43
 18715
READY
```

Listing 12: *This listing allows the record file to be updated without an excess of data manipulation. Records are maintained only for the most recent ten races. The last digit of the total races run by a horse is used as a pointer. When race number 11 occurs, the results are written into location 1, replacing race number 1 (old data). In this way we avoid shifting the entire record file every time a new race is run.*

```
LOAD A6,2
READY
40
50
70 C=(A-1)*60
90
100
210 FORC=ATOA+9:B=(A-1)*60:IFB>540THENB=B-540
RUN

 8 0 27
 8 0 30
 8 0 38
 18872
READY
LIST

5 DIMV(12)
10 GOSUB 9857\!U1,U2,U3
20 OPEN#0,"A4,2"
30 FORA=1TO10
70 C=(A-1)*60
80 WRITE#0%C,V(1),V(2),V(3),V(4),V(5),V(6),V(7)
110 WRITE#0,V(8),V(9),V(10),V(11),V(12),NOENDMARK
120 NEXT
130 GOSUB 9857\!U1,U2,U3
200 FORA=1TO5
210 FORC=ATOA+9\B=(A-1)*60\IFB>540THENB=B-540
220 READ#0%B,V(1),V(2),V(3),V(4),V(5),V(6),V(7),V(8),V(9),V(10),V(11),V(12)
240 NEXT
245 NEXT
250 GOSUB 9857\!U1,U2,U3
260 !FREE(0)
270 END
9857 FORU=0TO7\U(U)=INP(168+U)\NEXT\U1=10*U(7)+U(6)
9858 U2=10*U(5)+U(1)\U3=10*U(2)+U(3)\RETURN
READY
```

Text continued from page 164:
measurement of time is given in seconds. The procedure will be called method 1.

In listing 11, the program was edited to eliminate the use of loops in indexing read/write variables. This is called method 2 and is considerably faster than method 1.

In the racing game only the ten most current performance records for each horse are maintained. In the two tests already timed, this was done by keeping each record in a predetermined location. The most current record is always at a specified location followed by the next most current record, etc. This simplifies the read operations. However, each time a new record is added, the entire record file is shifted to accommodate for the addition of a new record, the new record is written in the first (most recent) position, and the record that was formerly in the tenth position is discarded.

Instead of employing this procedure, method 3 was formulated by additional editing shown in listing 12. The location of the oldest record is calculated, and the new record is placed in that location. For example, the last digit of the total races run by a horse is used as the pointer. If a horse has run one race, we write to location 1, location 2 for the second race, etc. When race number 11 occurs, it is written to location 1, replacing race 1 (the oldest). Race 12 replaces the second race, etc. This procedure reduces the number of disk writes required to update the file, but adds a calculation for all writes and reads.

Table 3 compares the three methods. Method 1 is the least effective, method 3 proves to be the best. Method 3 is a little slower than method 2 in reading files, but is far superior in writing disk files. Procedures similar to method 3 were employed in program RACE.

Aside from being entertaining, I hope that game RACE offers a few ideas in reducing program execution time and limiting the amount of data stored. ■

	Method 1	Method 2	Method 3
Time in seconds:			
To write 10 new records	54	37	3
To read all records 5 times	9	6	8

Table 3: *A comparison of the three methods of record maintenance.*

Listing 13: *BASIC listing of the RACE-I program.*

```
READY
LIST
10 DIM R(13),D(6)
20 FORA=1TO13\READR(A)\NEXT
30 DATA45859599,40708595,35608090,30608090,30557590,25507085,20406080
40 DATA15305075,10254570,10204070,5153565,5153060,51555
50 OPEN#0,"RACE-D"
55 N$="----------"
56 GOTO200
57 INPUT"RETURN TO ENTER HORSES OR ANYTHING TO CLEAR FILE ? ",Z$
58 IFZ$<>""THEN200
60 INPUT"RETURN TO READ RATINGS OR ANYTHING TO INPUT ? ",Z$
62 IFZ$=""THEN300
68 INPUT"ID, NAME ? ",A,A$\IFA<0ORA>39THENEND\A$=A$+N$
70 INPUT"CLASS AND 6 RATINGS ? ",C,R1,R2,R3,R4,R5,R6
80 A=2000+(A*572)
90 WRITE#0%A,A$,C,R(R1),R(R2),R(R3),R(R4),R(R5),R(R6),NOENDMARK
100 GOTO60
200 FORA=0TO99\WRITE#0,I,I,I,I,NOENDMARK\NEXT
210 FORA=0TO39\B=2000+(A*572)+47\WRITE#0%B,I,I,I,I,I,NOENDMARK\NEXT\END
300 FORA=0TO39\B=2000+(A*572)
310 READ#0%B,A$,F,D(1),D(2),D(3),D(4),D(5),D(6)
320 FORB=1TO6\FORC=1TO13\IFD(B)=R(C)THENEXIT330\NEXT\GOTO335
330 D(B)=C
335 NEXT
340 !     A$,%5I,F,D(1),D(2),D(3),D(4),D(5),D(6)\NEXT\END
READY
```

Listing 14: *North Star BASIC listing of the RACE program for an 8080-based computer.*

```
1 INPUT"RANDOM NUM ? ",B\FORA=0TOB\C=RND(0)\NEXT
5 INPUT"# OF HORSES ? ",U\IFU/2<>INT(U/2)THENU=U+1
7 IF U<0ORU>40THEN5\A=U*10\U=U-1
10 DIMT$(864),T1$(54),T3$(60),N$(12),M(12,6,4),F(4),O(12),I(1,12),L(12)
15 F(1)=1000000\F(2)=10000\F(3)=100\F(4)=1
20 DIMH(U,11),H$(A),R(99,3),R$(48),A(12, ?),K(12),P(4)
22 R$="STAKES  ALLOW.  CONDIT. MAIDEN  HANDICAPWORKOUT "
25 INPUT"FILE: ",M$\OPEN#0,M$
30 T2$="......"\LINE80\N$="1234567890AB"
35 P(1)=.65\P(2)=.2\P(3)=.1\P(4)=.05
40 FORA=0TO99\READ#0,R(A,0),R(A,1),R(A,2),R(A,3)\IFR(A,0)=0THENEXIT50
45 NEXT
50 Y=A\FORA=0TO U\A1=(10*A)+1\A2=(572*A)+2000
60 READ#0%A2,H$(A1,A1+9),H(A,0),H(A,1),H(A,2),H(A,3),H(A,4),H(A,5)
65 READ#0,H(A,6),H(A,7),H(A,8),H(A,9),H(A,10),H(A,11)\NEXT
70 !" "
75 !"1 FOR LIST OF HORSES"\!"2 FOR STATISTICS"\!"3 FOR RACE"
80 INPUT1"0 TO END ? ",A\!"          ",FREE(0)\IFA=0THEN9950\IFA>3THEN70\!""
90 IFA=1THENGOSUB5000\IFA=2THENGOSUB6000\IFA=3THENGOSUB7000\GOTO70
```

Listing 14 continued on next page

Listing 14 continued:

```
5000 !"ID NAME          R#  1  2  3     $ WON ID NAME          R#  1  2  3",
5010 !"      $ WON"\FORZ=1TO75\!"=",\NEXT\!""\Z5=INT(U/2)
5015 FORZ=0TOZ5\FORZ1=0TO1\Z2=Z\IFZ1=1THENZ2=Z2+Z5+1
5020 Z3=(Z2+1)*10\!%2I,Z2," ",
5030 !    H$(Z3-9,Z3),%3I,H(Z2,7),H(Z2,8),H(Z2,9),H(Z2,10),%$9F0,H(Z2,11),
5040 IFZ1=0THEN!" ",\NEXT\!""\NEXT\INPUT"READY TO RETURN ? ",Z$\RETURN
6000 INPUT"ID# ? ",V3\V4=(V3*10)+1
6010 !H$(V4,V4+9),\FORV4=7TO11\!H(V3,V4),\NEXT\!""\IFH(V3,7)=0THENRETURN
6020 !"DAY RACE T      PURSE-#H DIS   TIME WGH  P  S  H  S  F  L  ",
6025 !"TIME   ODDS WINNER"\FORV4=1TO79\!"=",\NEXT\!""
6040 V4=H(V3,7)\V5=V4-(INT(V4/10)*10)\IFV5=0THENV5=10\V5=V5-1
6050 FORV6=V5TOV5-9STEP-1\V=V6\IFV >-1THEN6070
6060 IFV4<11THENEXIT6099\V=V+10
6070 V=2000+(V3*572)+72+(V*50)
6080 READ#0%V,Z,Z1,Z2,Z3,Z4,Z5,Z6,Z7,Z8,Z9
6085 X1=R(Z,0)\X2=INT(X1/10000)\X1=X1-(10000*X2)\X3=INT(X1/100)\X4=X1-(100*X3)
6087 X5=8*X2\!%3I,Z," ",R$(X5-7,X5),%$8F0,R(Z,1),"-",%2I,X4,%3I,X3,"F",
6088 T=R(Z,2)\X3=(R(Z,3)*10)+1
6089       GOSUB9600\!%2I,T1,":",%2I,T2,".",%1I,T,%4I,Z1,%3I,Z2,Z3,Z4,Z5,Z6,Z7,
6091 T=Z8\GOSUB9600\!%2I,T1,":",%2I,T2,".",%1I,T," ",%6F2,Z9," ",
6094 IFX3+7>(U+1)*10THEN6096
6095 !H$(X3,X3+7),
6096 !""\NEXT
6099 RETURN
7000 !"TYPES ARE 1=STAKES 2=ALLOWANCE 3=CONDITIONED 4=MAIDEN",
7001 !" 5=HANDICAP 6=WORKOUT"
7002 !"DISTANCE= 6 TO 12 FURLONGS  MAXIMUM HORSES = 12"
7004 INPUT"TYPE, DISTANCE, HORSES? ",W,X2,X3
7010 IFW<>6ANDX3<4THEN7000
7020 IFX2<6ORX2>12ORX3<1ORX3>12THEN7000\X6=INT((X2+ 1)/2)
7022 IFW<1ORW>6THEN7000\I9=0\IFW=3ORW=4THENGOSUB8200
7025 IFI9=1THEN7030\INPUT"YES FOR AUTOMATTC SELECT. ? ",Z$
7027 IFZ$="YES"THENGOSUB8200
7030 FORX4=1TOX3\IFI9=1THEN7047\!"POST",%3I,X4,
7040 INPUT" ID#? ",V1\IFV1<0ORV1>UTHEN7040\GOTO7048
7047 V1=I(1,X4)\X5=(10*V1)+1\!"POST",%3I,X4,"  ",H$(X5,X5+9)
7048 A(X4,0)=V1\A(X4,1)=120
7050 FORX5=1TOX6\X8=H(V1,X5)\FORX7=1TO4
7060 M(X4,X5,X7)=INT(X8/F(X7))\X8=X8-(M(X4,X5,X7)*F(X7))
7064 IFM(X4,X5,X7-1)>M(X4,X5,X7)THENM(X4,X5,X7)=100
7068 X9=M(X4,X5,X7)-M(X4,X5,X7-1)\O(X4)=O(X4)+(X9*X7)
7070 NEXT\O(X4)=O(X4)+((100-M(X4,X5,4))*5)+(H(V1,0)*100)\NEXT
7080 X8=0\FORX7=1TOX3\X8=X8+O(X7)\NEXT
7082 X8=INT((X8/(X2*4))*(6-W)*.025)\U1=X8*1000
7090 K(X4)=X4\NEXT\IFW=2ORW=5 THENGOSUB9400\GOSUB9300
7100 GOSUB8000\X4=6\IFX3<6THENX4=X3\X5=0\IFX3>6THENX5=X3
7110 IFZ$<>""THENRETURN
7120 X7=2+(12*X2)\FORX8=1TOX4\X9=X7+((X8-1)*144)\IFX9>864THENX9=X9-864
7122 T$(X9,X9)=N$(X8,X8)\L(X8)=X9\NEXT
7125 X7=3+(12*X2)\FORX8=7TOX5\X9=X7+((X8-1)*144)\IFX9>864THENX9=X9-864
7126 IFX9>864THENX9=X9-864
7127 T$(X9,X9)=N$(X8,X8)\L(X8)=X9\NEXT
7130 FORX4=1TOX3\A(X4,2)=2+(12*X2)\K(X4)=X4\NEXT\GOSUB9000
7140 FORV=1TOX6\V1=1\IFV<>X6THEN7150\IF2*X6>X2THENV1=.5
7150 FORV2=1TOX3\V3=K(V2)\V4=INT(RND(0)*100)\V6=A(V3,0)
7160 FORV5=1TO4\IFM(V3,V,V5)>V4THENEXIT7180
7170 NEXT\V5=5
7180 V5=V5+19+H(V6,0)\IFV=X6THENV5=V5*V1\V5=V5+((120-A(V3,1))/X6)
7190 A(V3,2)=A(V3,2)-V5\Z9=A(V3,2)
7195 IFZ9>1THEN7200\Z9=Z9+144\GOTO7195
7200 A(V3,3)=0\FORV7=0TO720STEP144\V8=Z9+V7
```

Listing 14 continued on page 176

SYBEX BRIDGES THE GAP



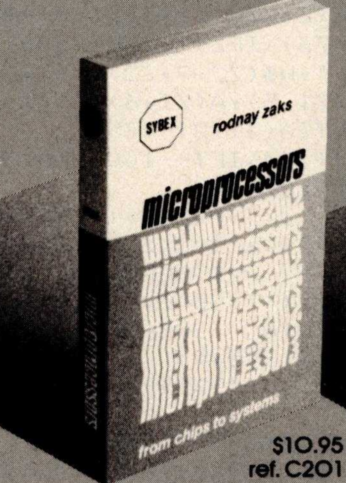
$12.95
ref. C202

A comprehensive introduction to microprocessor programming, using the 6502. From basic concepts to advanced data structures. Complete explanation of internal register and bus operation. The basic 6502 textbook.



$12.95
ref. D302

How to connect with the outside world and implement practical applications. Programs and circuits are presented, from home control to industrial applications, including analog-digital conversion. The I/O book for the 6502.



$10.95
ref. C201

From the ground up: the components (ROM, RAM, MPU, UART, PIO), their interconnect, applications, programming, system development. Used by educational institutions worldwide. "The basic text on microprocessors."



$14.95
ref. C207

How to connect a microprocessor to the outside world. Includes the peripherals, from keyboard to CRT and floppy disk, as well as A/D conversion, standard buses (S100 to IEEE 488) and basic troubleshooting.



$12.95
ref. G402

An educational text on advanced programming techniques. Includes programs and hardware design for a variety of games, ranging from music to mastermind or tic-tac-toe. "Complex algorithms can be fun."



$14.95
ref. C281

A comprehensive introducion to programming the Z80 family. From basic programming to interrupts and time-sharing, including input-output techniques and common utility programs. A self-contained text.



$14.95
ref. C280

A comprehensive introduction to microprocessor programming, using the Z80. From basic concepts to advanced data structures. Complete explanation of internal register and bus operation. "The basic Z80 textbook."



Dept. IA3
2344 Sixth Street
Berkeley, Ca. 94710

TO ORDER:
By Phone: (415) 848-8233. Visa, MC, American Express
By Mail: Indicate quantity desired. Prepayment required
Shipping: Add $1.50 per book (UPS) or 75¢ (4th Class–allow 4 weeks delivery)
Tax: In California please add tax.

Please send me the following:
____
____
Name__________
Company__________
Address__________
City______ State___ Zip____
Amount enclosed__________
Charge my: ☐ Visa ☐ Master Charge ☐ American Express
Card number__________
Expiration date__________
Signature________ Date______
☐ Send me your detailed catalog

AVAILABLE AT BOOK AND COMPUTER STORES EVERYWHERE

Circle 98 on inquiry card.

Listing 14 continued:

```
7210 IFT$(V8,V8)="."THENEXIT7250
7220 IFT$(V8,V8)=":"THENEXIT7250
7230 IFT$(V8,V8)="1"THENEXIT7250
7240 A(V3,3)=A(V3,3)-.1\NEXT\Z9=Z9+1\A(V3,2)=A(V3,2)-1\GOTO7195
7250 T$(V8,V8)=N$(V3,V3)\L(V2)=V8\NEXTV2
7260 V2=0\FORV3=1TOX3-1\V4=K(V3)\V5=K(V3+1)\V6=A(V4,2)+A(V4,3)
7270 V7=A(V5,2)+A(V5,3)\IFV6<=V7THEN7290
7280 V2=1\K(V3)=V5\K(V3+1)=V4
7290 NEXT\IFV2=1THEN7260\GOSUB9000\GOSUB7900\NEXT\INPUTZ$\GOSUB7300\RETURN
7300 FORZ=1TO3\!" "\NEXT\GOSUB9500
7303 !"ID NAME           WT  F  S  H  S  F.BY  L M:SS.F      ODDS"
7305 !"=================================================================="
7310 FORZ=1TOX3\Z1=K(Z)\Z2=(1+A(Z1,0))*10\IFZ=1THENZ3=A(Z1,2)-.75
7320 Z4=INT(A(Z1,2)-Z3)\IFZ<>1THEN7330\Z4=K(2)\Z4=INT(A(Z4,2)-Z3)
7330 !%2I,A(Z1,0)," ",H$(Z2-9,Z2),%4I,A(Z1,1),%3I,Z1,
7340 !%3I,A(Z1,4),A(Z1,5),A(Z1,6),A(Z1,7)," BY",%3I,Z4,
7345 A(Z1,8)=Z4\T=INT(A(Z1,2)-.75)
7347 IFT<-100THENT=T+144\IFT<-100THEN7347\T=T+(65*X2)-48
7348 A(Z1,9)=T\GOSUB9600
7349 !%2I,T1,":",%2I,T2,".",%1I,T,%9F2,O(Z1)\Z1=A(Z1,0)
7350 IFW<>6THENGOSUB9700\Z1=K(Z)\O(Z1)=0\NEXT
7351 IF6=WTHEN7360\IFV2<2.1THENV2=2.1\IFV3<2.1THENV3=2.1\GOSUB9900
7352 IFV4<2.1THENV4=2.1\IFV5<2.1THENV5=2.1\IFV6<2.1THENV6=2.1
7353 !""\!"POST         WIN     PLACE      SHOW"
7354 !%4I,K(1),%$9F2,V1,V2,V3
7356 !%4I,K(2),"                ",%$9F2,V4,V5
7358 !%4I,K(3),"                          ",%$9F2,V6
7360 !""\INPUT"READY? ",Z$\!""\RETURN
7900 Z=0\IFV=1THENZ=4\IFV=X6-1THENZ=6\IFV=2THENZ=5
7910 IFV=X6THENZ=7\IFZ=0THENRETURN
7920 FORZ1=1TOX3\Z2=K(Z1)\A(Z2,Z)=Z1\IFV=2THENA(Z2,6)=Z1\NEXT\RETURN
8000 T3$="............................................................"
8010 FORZ=1TO15\T$=T3$+T$\NEXT
8020 FORZ=1TO133STEP12\T4$=":"\IFZ=1THENT4$="I"
8030 FORZ1=0TO720STEP144\Z2=Z1+Z\T$(Z2,Z2)=T4$\NEXT\NEXT
8040 FORZ=1TO12\A(Z,2)=0\A(Z,3)=0\NEXT
8100 !""\IFW=6THENU1=0\Z=W*8\!"THIS IS A",X2," FURLONG ",R$(Z-7,Z),
8105 !" RACE WITH A PURSE OF $",U1
8110 !""\!"POST NAME        WGH     ODDS  R# 1ST 2ND 3RD   EARNINGS"
8120     !"============================================================="
8125 FORZ=1TOX3\Z1=A(Z,0)+1\Z2=Z1-1
8130 Z1=Z1*10\!%4I,Z," ",H$(Z1-9,Z1),%4I,A(Z,1),%$8F2,O(Z),
8132 !%4I,H(Z2,7),H(Z2,8),H(Z2,9),H(Z2,10),%$11F0,H(Z2,11)
8134 NEXT\IFX3>3ORW=6THEN8140\!""\!"TOO FEW HORSES"\Z$="K"\RETURN
8140     !""\INPUT"RETURN FOR RACE OR ANYTHING TO KILL ? ",Z$\RETURN
8200 IFW<>3THEN8202\INPUT"MAX $/RACE EARNED ? ",Z5
8202 INPUT"ID START & ID END SEARCH ? ",A,B\IFA>BTHEN8202
8203 IFA<OTHEN8202\IFB>UTHEN8202
8205 FORZ=1TOX3\I(0,Z)=-999999\I(1,Z)=0\NEXT\Z4=0\I9=1
8210 FORZ=ATOB\IFH(Z,7)=0THEN8215\Z1=H(Z,11)/H(Z,7)\IFW=5THENZ1=0-Z1
8215 IFH(Z,8)>0ANDW=4THEN8260
8217 IFZ1>Z5ANDW=3THEN8260
8220 FORZ2=1TOX3\IFI(0,Z2)>Z1THEN8250
8230 FORZ3=X3TOZ2+1STEP-1\I(0,Z3)=I(0,Z3-1)\I(1,Z3)=I(1,Z3-1)\NEXT
8240 Z4=Z4+1\I(0,Z2)=Z1\I(1,Z2)=Z\EXIT8260
8250 NEXT
8260 NEXT\IFZ4<X3THENX3=Z4\RETURN
9000 FORZ=1TO11\!" "\NEXT
9001 FORZ=5TO-3STEP-1\Z1=Z*144\IFZ>-2THEN9008
9002 IFZ=-2THEN!"      ",T2$(1,2),
9004 IFZ=-3THEN!"      ",T2$(1,4),\GOTO9009
9008 !"      ",
```

```
9009 FORZ2=43TO47STEP2
9010 Z3=Z1+Z2+(144*((49-Z2)/2))\IFZ3>864THEN9020
9015 IFZ3<1THEN9020\!T$(Z3,Z3+1),\GOTO9030
9020 !"  ",
9030 NEXT\IFZ>-1THEN!T$(Z1+49,Z1+102),\IFZ<0THEN!T1$,
9032 IFZ=-2THEN!"  ",\IFZ=-3THEN!"      ",
9038 FORZ2=107TO103STEP-2
9040 Z3=Z1+Z2+(144*((109-Z2)/2))\IFZ3>864ORZ3<1THEN9050\!T$(Z3,Z3+1),
9050 NEXT\IFZ=-2THEN!T2$(1,2),\IFZ=-3THEN!T2$(1,4),\!" "\NEXT
9060 FORZ=42TO37STEP-1\FORZ1=720TO0STEP-144\Z2=Z+Z1\!T$(Z2,Z2),\NEXT
9062 Z4=43-Z\IFZ4>X3THEN9070\Z4=K(Z4)\Z5=A(Z4,0)
9064 Z6=(Z5+1)*10\!TAB(20),H$(Z6-9,Z6),"(#",%2I,Z4,")",
9066 Z4=49-Z\IFZ4>X3THEN9070\Z4=K(Z4)\Z5=A(Z4,0)
9068 Z6=(Z5+1)*10\!TAB(40),H$(Z6-9,Z6),"(#",%2I,Z4,")",
9070 !TAB(72),\FORZ1=0TO720STEP144\Z2=Z1+151-Z\!T$(Z2,Z2),\NEXT\!""\NEXT
9100 FORZ=-3TO5          \Z1=Z*144\IFZ>-2THEN9108
9102 IFZ=-2THEN!"        ",T2$(1,2),
9104 IFZ=-3THEN!"   ",T2$(1,4),\GOTO9109
9108 !"       ",
9109 FORZ2=36TO32STEP-2
9110 Z3=Z1+Z2+(144*((Z2-30)/2))\IFZ3>864THEN9120
9115 IFZ3<2THEN9120\!T$(Z3,Z3),T$(Z3-1,Z3-1),\GOTO9130
9120 !"  ",
9130 NEXT\IFZ<0THEN9150\FORZ2=30TO1STEP-1\Z3=Z2+Z1\!T$(Z3,Z3),\NEXT
9140 FORZ2=144TO121STEP-1\Z3=Z2+Z1\!T$(Z3,Z3),\NEXT
9150 IF0>ZTHEN!T1$,\IFZ=-2THEN!"  ",\IFZ=-3THEN!"    ",
9160 FORZ2=120TO116STEP-2\Z3=Z1+Z2+(144*((122-Z2)/2))
9170 IFZ3>864OR2>Z3THEN9180\!T$(Z3,Z3),T$(Z3-1,Z3-1),
9180 NEXT\IFZ=-2THEN!T2$(1,2),\IFZ=-3THEN!T2$(1,4),
9190 IFZ<>5THEN!""\NEXT
9195 FORZ2=1TOX3\Z3=L(Z2)\T$(Z3,Z3)="."\NEXT\RETURN
9300 IFW=6THEN9350
9305 Z=99999\FORZ1=1TOX3\IFO(Z1)<ZTHENZ=O(Z1)\NEXT
9310Z2=0\Z=Z+ 20\FORZ1=1TOX3\O(Z1)=O(Z1)-Z\IFO(Z1)<20THENO(Z1)=20
9330 Z2=Z2+O(Z1)\NEXT\Z2=Z2*1.70\FORZ1=1TOX3\O(Z1)=INT((Z2/O(Z1))*2.5)
9340 O(Z1)=(O(Z1)/5)-1\IFO(Z1)<.20THENO(Z1)=.2\NEXT\RETURN
9350 FORZ1=1TOX3\O(Z1)=0\NEXT\RETURN
9400 Z2=0\FORZ1=1TOX3\Z2=Z2+O(Z1)\NEXT\Z2=Z2/X3
9420 FORZ1=1TOX3\Z3=INT(((O(Z1)-Z2)/100)+.5)\IFW=2THENZ3=INT(Z3*.5)
9430 IFZ3<-10THENZ3=-10\IFZ3>10THENZ3=10\O(Z1)=O(Z1)-(100*Z3)
9440 A(Z1,1)=120+Z3\NEXT\RETURN
9500 V7=K(1)\V1=O(V7)*2+2\V2=O(V7)+2\V3=O(V7)*.66+2\V3=INT((V3*20)/20)
9510 V3=V3*.20\V7=K(2)\V4=O(V7)+2\V5=O(V7)*.66+2\V5=INT((V5*20)/20)
9520 V5=V5*.2\V7=K(3)\V6=O(V7)*.66+2\V6=INT((V6*20)/20)\V6=V6*.2
9530 V3=V3+2\V5=V5+2\V6=V6+2\RETURN
9600 T1=INT(T/300)\T=T-(300*T1)\T2=INT(T/5)\T=T-(5*T2)\RETURN
9601 T1=INT(T/300)\T=V-(300*T1)\T2=INT(T/5)\T=T-(5*T2)\RETURN
9700 T3=H(Z1,7)+1\H(Z1,7)=T3\IFZ>3THEN9710\H(Z1,7+Z)=H(Z1,7+Z)+1
9710 IFZ>4THEN9800\H(Z1,11)=H(Z1,11)+(P(Z)*U1)
9800 T4=T3-(INT(T3/10)*10)\IFT4=0THENT4=10\T4=T4-1
9810 T5=2000+(572*Z1)+72+(T4*50)\Z1=K(Z)\Q=Z
9820WRITE#0%T5,Y,A(Z1,1),Z1,A(Z1,4),A(Z1,5),A(Z1,6),A(Z1,7),NOENDMARK
9825 WRITE#0%T5+35,A(Z1,8),A(Z1,9),O(Z1),NOENDMARK\RETURN
9900 R(Y,0)=(W*10000)+(X2*100)+X3\R(Y,1)=U1\T4=K(1)\R(Y,2)=A(T4,9)
9910 T4=K(1)\R(Y,3)=A(T4,0)\Y=Y+1\RETURN
9950 CLOSE#0\OPEN#0,M$
9960 FORA=0TO99\WRITE#0,R(A,0),R(A,1),R(A,2),R(A,3)
9970 IFR(A,0)=0THENEXIT9980\NEXT
9980 FORA=0TOU\A1=(572*A)+2000+47
9990 WRITE#0%A1,H(A,7),H(A,8),H(A,9),H(A,10),H(A,11),NOENDMARK\NEXT
9995 CLOSE#0\END
READY
$F
```





Amateur Radio

Let your computer talk to another machine in Tokyo, London or Sri Lanka! Finally, this is a reality through Amateur Radio. ASCII transmissions by amateurs have just been approved by FCC. Now it's possible to link up your computer over the airwaves! Swap programs with an engineer in Paris, exchange data with an amateur at the South Pole. Your computer may even help coordinate relief efforts to an earthquake-stricken foreign country. Experience the thrill of this new dimension to computing. Get with "Amateur Radio," today!

Only $6.95 No. 94

Introduction to Low Resolution Graphics

Now you can produce amazing computer graphics — even if you can't draw a straight line. Literally! Learn how to draw lines and shapes, make graphs, draw pictures and even do animations. The simple secrets of how to do all this are contained in this new book by Nat Wadsworth. You'll be able to produce a deck of playing cards ... a clown that winks ... a football grid ... and an animated football game. Also tells how to synchronize computer-generated sounds to your illustrations.

Just $9.95 No. 65

SERIOUS

Understanding Microcomputers

Accepted as the standard! 300 page easy reading text. Explains exactly how a microprocessor works. Intro to programming in BASIC. Complete glossary.

Just $9.95 No. 90

Microcomputer Potpourri

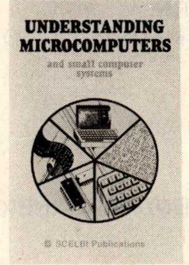
A pocket-size reference for the beginner and pro alike. Full digest on understanding microcomputers. Data and diagrams on all the popular chips. Glossary.

Only $2.95 No. 70

Learn Micro-Computers

A new multi-media information package for the beginner. You get Understanding Microcomputers book plus high-quality cassette. Great for self-study.

Just $14.95 No. 40







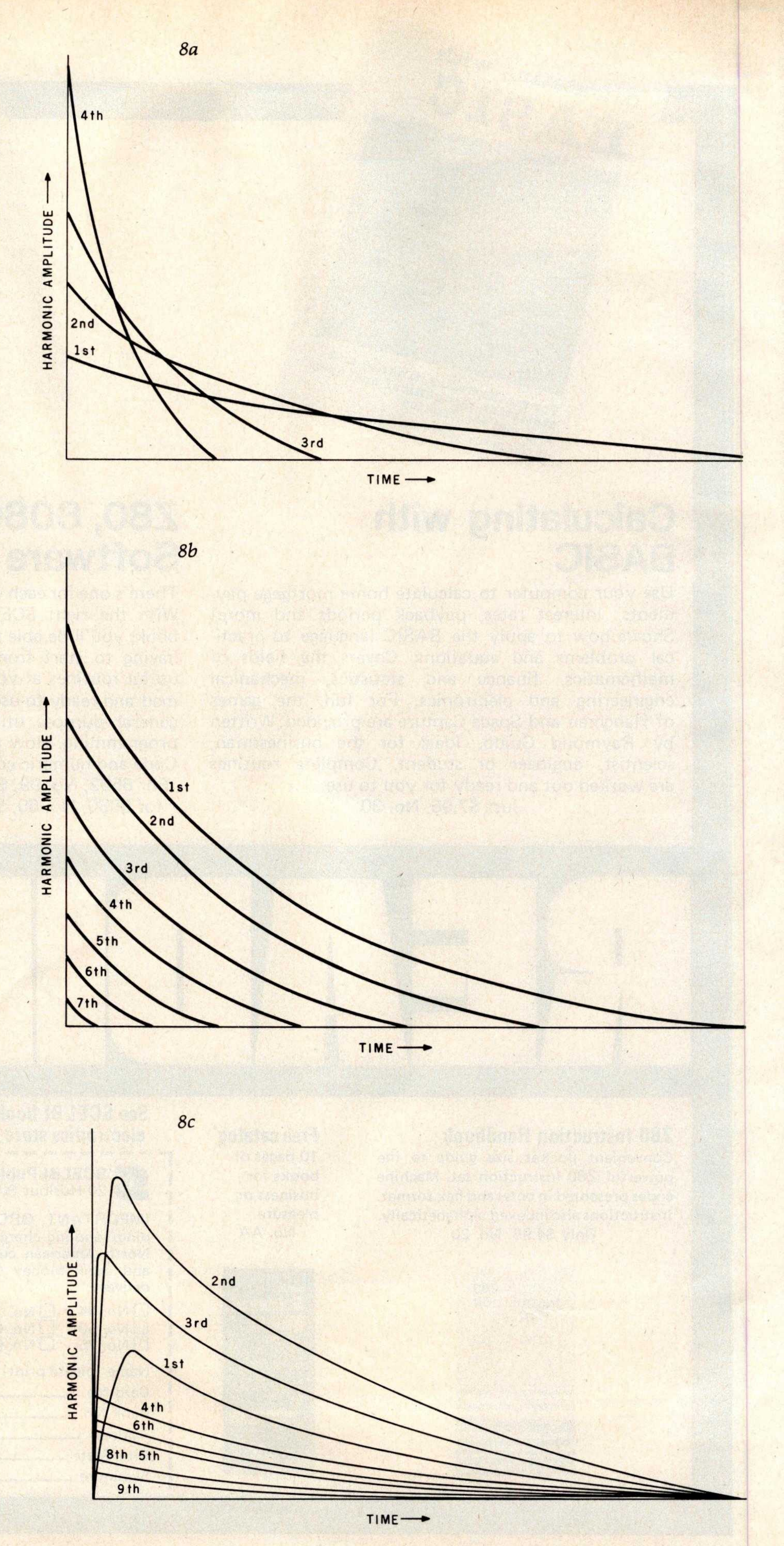
Text continued from page 94:
in a real-time microcomputer music system.

As before, we solve our problem by using a sequence of waveform tables to approximate the desired timbre envelope. In effect, we divide the time axis of the graph in figure 7b into a number of short intervals and compute a waveform table based on the average amplitude of each harmonic during the interval. If the waveform tables are used in sequence properly, the envelope sampling need not be uniform; sampling can be dense (closely spaced) during the attack and decay when harmonic amplitudes are changing rapidly, and sparse in between when things are fairly static.

Note that a single sequence of waveform tables implements both the overall amplitude envelope and the timbre envelope for a given instrument simulation. In fact, for lack of a better name, we will call a specific sequence of waveform tables an *instrument* and the specifications for computing them an *instrument specification*.

In actually setting up a waveform-sequencing routine, it is convenient to use a *waveform-sequence table*. This table is simply a list of numbers (typically with 256 entries), where each number corresponds to a waveform table (and is typically the page address of the table). While notes are being played, a *waveform-sequence pointer* moves at a uniform speed (about 100 increments per second) through the sequence table. Nonuniform sampling of the harmonic envelopes (dense or sparse at different times) is accomplished by varying the number of *duplicate* entries in the sequence table. It is even possible to define several different instruments using the same set of *waveform* tables simply by making a different *sequence* table for each instrument. One sequence, for example, could be simply the reverse of another.

Do not underestimate the importance or power of this additive-synthesis technique in producing realistic instrument sounds and interesting music. The graphs of figure 8 show some typical instrument characteristics. When these characteristics are incorporated into the software system to be described shortly, the instruments really sound plucked (figures 8a and 8b), struck (figure 8c), bowed



(figure 8d), or blown (figure 8e).

The value of performing with a computer, however, lies in the concoction of new instruments such as those shown in figures 9 and 10.

The system I shall describe is sufficiently general and has sufficient correspondence between specifications and the actual sound produced that experimentation is encouraged. There is really nothing sacred about the sound of traditional instruments; they were mostly developed by trial and error, anyway. The real future of music lies in exploring the entire range of perceivable timbres, as well as in writing appropriate scores for various timbre groups.



Description of Music Software

In the remainder of this article, a music-playing program based on these principles will be described. The software is just a music interpreter that looks at compactly encoded music data in memory and carries out the specified tone-producing operations. In a complete music system, it is necessary to also have a music "compiler" that accepts a user-oriented "music language" and translates it into the format required by this interpreter.

Coding examples will be for the 6502 microprocessor. The maximum number of simultaneous voices is an arbitrary parameter that can be traded off against sample rate to the D/A converter. Using a clock frequency of 1 MHz on the 6502 processor, up to four voices are possible with an 8 kHz sample rate.

Basic Waveform-Scanning Code

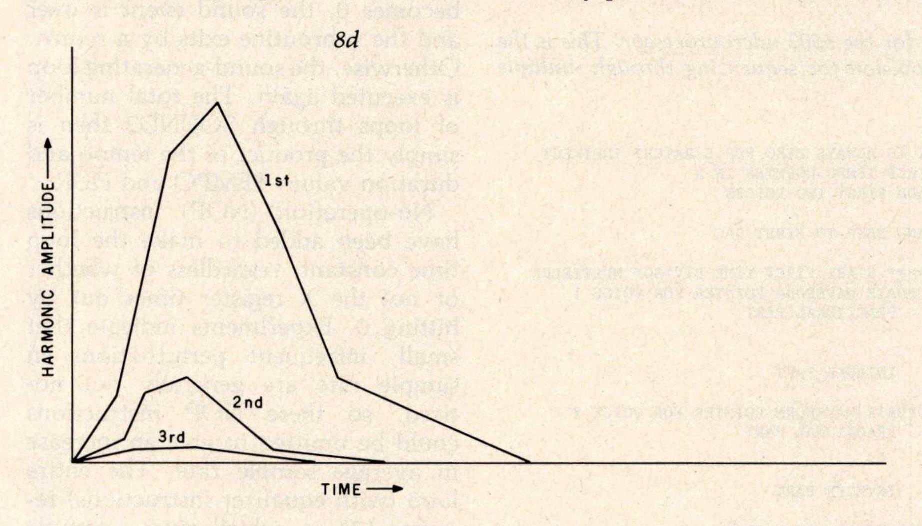
The core of the program is the sound-generation routine that scans the waveform tables. I shall describe this routine, which is given in listing 4, first in its use with fixed waveform tables, that is, using rectangular envelopes. Then a description of an enhancement of it for waveform sequencing will follow.

Before the waveform-scanning routine, SOUND, is called, ten parameters are established in memory by the calling routine. Four of these, the waveform-table pointers for each voice, are named WAVPT1 thru WAVPT4. The byte at WAVPTi+2 is the page number of the waveform table to be used for voice i. Four additional parameters, WAVIN1 thru WAVIN4, are the increments for the four waveform-table pointers. These pointer increments define the frequency for each of the four tones.

The last two parameters (TEMPO and DUR) are multiplied together to determine the duration, in sample periods, of sound generation before returning to the calling routine. DUR is normally used to specify the *relative* duration of the event while TEMPO specifies the overall speed of the event sequence. All of these parameters are kept in page 0 of memory for maximum speed of access.

In operation, the music-code interpreter sets up these ten parameters and calls SOUND for each musical event in the piece. An event is defined as the time between changes in the sound and is usually the duration of the shortest notes in a passage or chord. Since sound generation stops while the interpreter is setting up the next event, it is important that the interpreter be an efficient machine-language program was well.

Peering more deeply into the SOUND routine, we see that the value from location TEMPO is kept in the X register, DUR (the duration value) is left in memory, and the Y register is zeroed. In the 6502, the value of the Y register is added to indirect addresses, so "normal" indirect-address operation requires that Y contain 0.



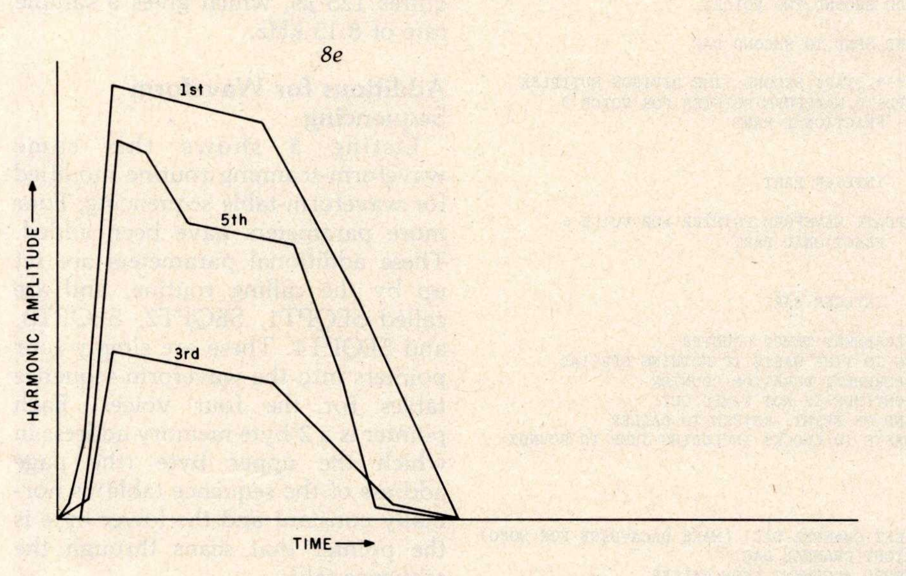


Figure 8: *Amplitude envelopes for harmonics present in notes produced by various types of instruments. (8a) First type of plucked-string instrument, a banjo, or a violin played pizzicato. (8b) Second type of plucked-string instrument, such as a lute or harpsichord. (8c) Struck-string instrument, such as a piano, in this case for the octave just below middle C at 261.6 Hz. (8d) Bowed-string instrument, such as a cello; for further data on this type, see reference 4. (8e) Blown reed or woodwind instrument, such as a clarinet; for further data on this type, see reference 5.*

We can see that during the loop starting at SOUND2 in listing 4, each of the pointer increments (WAVIN1, etc) is double-precision added to the corresponding waveform-table pointers (WAVPT1, etc). These are the integer and fractional parts of the pointers and increments. To save time, the initial state of the carry flag is ignored when the fractional parts are added together. (The state of the 6502 carry flag is always considered in an add instruction.)

The interesting part of the SOUND2 loop is the section which outputs samples that have been fetched from the waveform tables. In the top part of the loop, samples for voices 1 and 2 are averaged together and sent to one D/A converter while, later on, voices 3 and 4 are sent to another D/A converter. This stereo feature can be quite effective.

For monophonic output, the two D/A-converter addresses are simply made the same. Such action is actually an example of *time-division multiplexing*, another method of mixing simultaneous tones through a single D/A converter. The mixing actually takes place in the filter, due to its "hangover" effect between A-channel and B-channel samples in monophonic use.

Listing 4: *The basic waveform-scanning code for the 6502 microprocessor. This is the original version, which does not contain provision for sequencing through multiple waveform tables.*

```
0200 A000     SOUND:   LDY    #0             ; Y IS ALWAYS ZERO FOR STRAIGHT INDIRECT
0202 A600     SOUND1:  LDX    TEMPO          ; KEEP TEMPO COUNTER IN X
0204 18       SOUND2:  CLC                   ; ADD FIRST TWO VOICES
0205 B103              LDA    (WAVPT1+1),Y
0207 7106              ADC    (WAVPT2+1),Y   ; AND SEND TO FIRST DAC
0209 6A                RORA
020A 8D00FE            STA    DACA           ; **** START FIRST TIME DIVISON MULTIPLEX
020D A502              LDA    WAVPT1         ; UPDATE WAVEFORM POINTER FOR VOICE 1
020F 650E              ADC    WAVIN1         ;    FRACTIONAL PART
0211 8502              STA    WAVPT1
0213 A503              LDA    WAVPT1+1
0215 650F              ADC    WAVIN1+1       ;    INTEGER PART
0217 8503              STA    WAVPT1+1
0219 A505              LDA    WAVPT2         ; UPDATE WAVEFORM POINTER FOR VOICE 2
021B 6510              ADC    WAVIN2         ;    FRACTIONAL PART
021D 8505              STA    WAVPT2
021F A506              LDA    WAVPT2+1
0221 6511              ADC    WAVIN2+1       ;    INTEGER PART
0223 8506              STA    WAVPT2+1
0225 18                CLC                   ; ADD SECOND TWO VOICES
0226 B109              LDA    (WAVPT3+1),Y
0228 710C              ADC    (WAVPT4+1),Y   ; AND SEND TO SECOND DAC
022A 6A                RORA
022B 8D02FE            STA    DACB           ; **** START SECOND TIME DIVISON MUTIPLEX
022E A508              LDA    WAVPT3         ; UPDATE WAVEFORM POINTER FOR VOICE 3
0230 6512              ADC    WAVIN3         ;    FRACTIONAL PART
0232 8508              STA    WAVPT3
0234 A509              LDA    WAVPT3+1
0236 6513              ADC    WAVIN3+1       ;    INTEGER PART
0238 8509              STA    WAVPT3+1
023A A50B              LDA    WAVPT4         ; UPDATE WAVEFORM POINTER FOR VOICE 4
023C 6514              ADC    WAVIN4         ;    FRACTIONAL PART
023E 850B              STA    WAVPT4
0240 A50C              LDA    WAVPT4+1
0242 6515              ADC    WAVIN4+1       ;    INTEGER PART
0244 850C              STA    WAVPT4+1
0246 CA                DEX                   ; DECREMENT TEMPO COUNTER
0247 D005              BNE    SOUND3         ; GO TO TIME WASTE IF NOTHING SPECIAL
0249 C601              DEC    DUR            ; DECREMENT DURATION COUNTER
024B D0B5              BNE    SOUND1         ; CONTINUE IF NOT TIMED OUT
024D 60                RTS                   ; END OF EVENT, RETURN TO CALLER
024E EA       SOUND3:  NOP                   ; WASTE 10 CLOCKS INCLUDING JUMP TO SOUND2
024F EA                NOP
0250 4C5302            JMP    .+3
0253 4C0402            JMP    SOUND2

FE00          DACA     =      X'FE00         ; LEFT CHANNEL DAC  (MAKE DACA=DACB FOR MONO)
FE02          DACB     =      X'FE02         ; RIGHT CHANNEL DAC
0000 00       TEMPO:   .BYTE  0              ; TEMPO ARGUMENT FROM CALLER
0001 00       DUR:     .BYTE  0              ; DURATION ARGUMENT FROM CALLER
0002 000000   WAVPT1:  .BYTE  0,0,0          ; VOICE 1 WAVE TABLE POINTER  FRAC,INT,WAVE
0005 000000   WAVPT2:  .BYTE  0,0,0          ; VOICE 2
0008 000000   WAVPT3:  .BYTE  0,0,0          ; VOICE 3
000B 000000   WAVPT4:  .BYTE  0,0,0          ; VOICE 4
000E 0000     WAVIN1:  .BYTE  0,0            ; VOICE 1 POINTER INCREMENT   FRAC,INT
0010 0000     WAVIN2:  .BYTE  0,0            ; VOICE 2
0012 0000     WAVIN3:  .BYTE  0,0            ; VOICE 3
0014 0000     WAVIN4:  .BYTE  0,0            ; VOICE 4
```

Time-division multiplexing has the advantage of providing the equivalent of a 9-bit D/A converter and the disadvantage of requiring a better filter on the D/A converter. The rearrangement of processing tasks in the main loop is necessary so that the durations of the dwell time of A-channel and B-channel samples are approximately equal. Inequality in these durations leads to a volume imbalance when set up for monophonic output.

At the bottom of the SOUND2 loop, register X, which contains the TEMPO parameter, is decremented. If X becomes 0, it is reloaded from TEMPO and DUR is decremented directly in memory. If DUR also becomes 0, the sound event is over and the subroutine exits by a return. Otherwise, the sound-generating loop is executed again. The total number of loops through SOUND2 then is simply the product of the tempo and duration values TEMPO and DUR.

No-operation (NOP) instructions have been added to make the loop time constant, regardless of whether or not the X register times out by hitting 0. Experiments indicate that small, infrequent perturbations in sample rate are generally not noticed, so these NOP instructions could be omitted to give an increase in average sample rate. The entire loop (with equalizer instructions) requires 123 μs, which gives a sample rate of 8.13 kHz.

Additions for Waveform Sequencing

Listing 5 shows this same waveform-scanning routine modified for waveform-table sequencing. Four more parameters have been added. These additional parameters are set up by the calling routine, and are called SEQPT1, SEQPT2, SEQPT3, and SEQPT4. These are simply four pointers into the waveform-sequence tables for the four voices. Each pointer is a 2-byte memory address in which the upper byte (the page address of the sequence table) is normally constant and the lower byte is the pointer that scans through the sequence table.

The additional code for waveform-table sequencing is split into two sections. The first section of code accesses the four waveform-sequence tables and stores the data found into the page address parts of the

waveform-table pointers (WAVPT1, etc). The second section of code increments the lower parts (byte addresses) of the sequence-table pointers (SEQPT1, etc). Both sections need to be executed only when index register X (which is initialized with the TEMPO parameter) underflows and is reinitialized; this typically occurs every 75 to 150 sample periods. On other passes through the waveform-scanning loop, time-wasting instructions of equivalent duration would need to be executed.

In the actual code of listing 5, we see that the sequence-table lookup instructions have been placed at the beginning of the loop at SOUND1; thus these instructions are guaranteed to be executed first thing when the routine is entered. This is necessary in case the calling routine has changed one of the sequence-table pointers, to assign a different instrument to a voice.

SOUND2 begins the waveform-table-lookup instructions, which are the same as before. At SOUND3, TEMPO (in index-register X) and the duration value DUR are decremented, while at SOUND4 the waveform-sequence-table pointers are incremented if X was decremented to zero. Note that the sequence-table-lookup instructions at SOUND1 are *not* executed until one sample period *after* the pointers are incremented, by virtue of control branching back to SOUND2 at the end of SOUND4, instead of to SOUND1. This in effect uses the instructions at SOUND1 as a time equalizer and greatly speeds up the routine.

As written, the sample period lasts for 145 processor clock pulses, which gives a sample rate of 6.89 kHz for four voices. If the routine is rewritten for instruction self-modification and put in page 0, the sample rate can be increased to 7.81 kHz (128 clock pulses), which is a much better match to the D/A converter filter designed for the earlier SOUND routine.

Higher-speed versions of the 6502, such as those found in Ohio Scientific, Atari, and Micro Technology processor boards, can give either higher sample rates or more voices, or both. For example, a 2 MHz 6502A could provide six voices with an 11-kHz sample rate, and a 3 MHz unit could provide eight voices at a 12.6 kHz rate, the same frequency response as an AM radio!

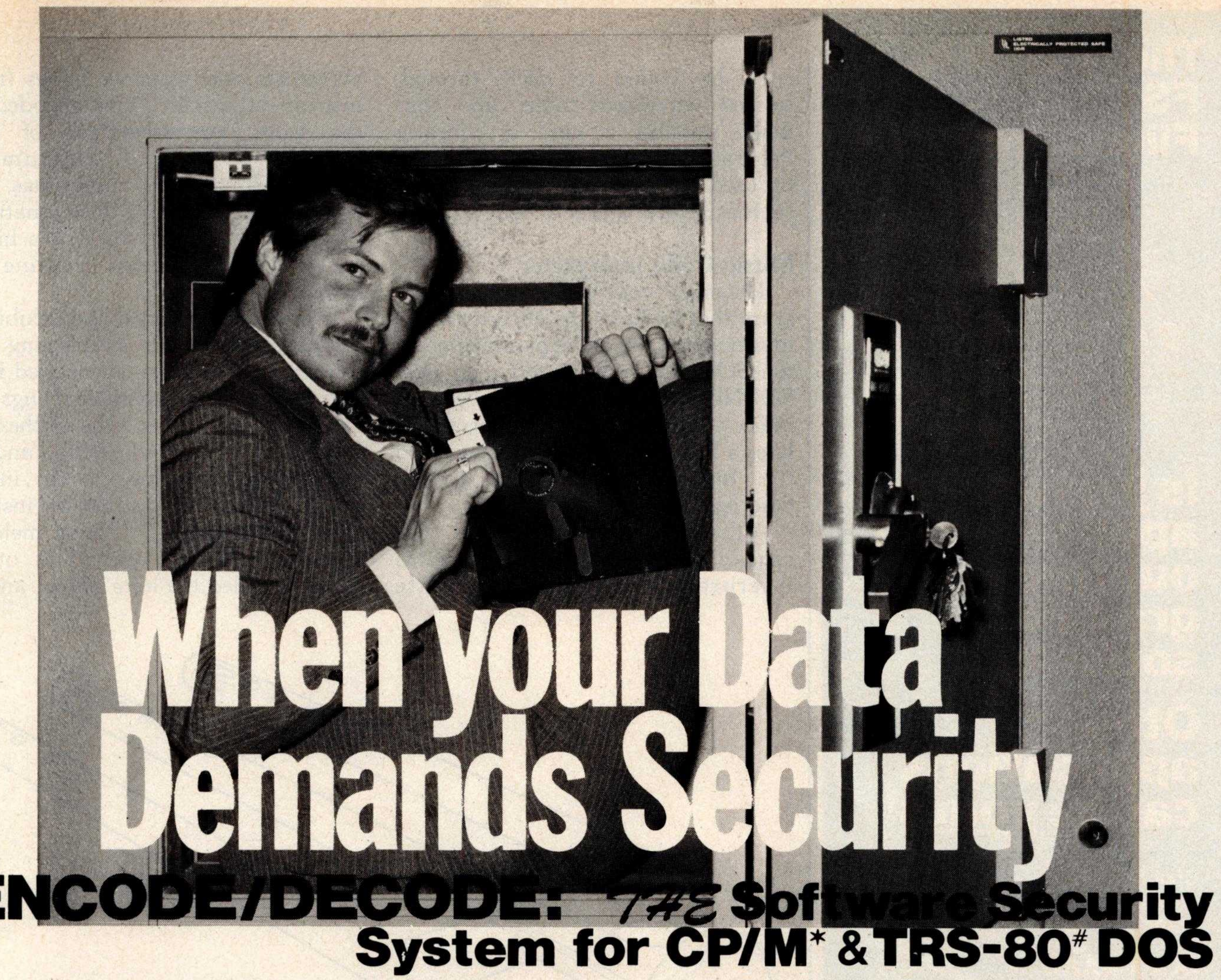
The use of waveform-sequence tables offers a great deal of flexibility in handling amplitude envelopes. To start a note with a given voice, its sequence-table pointer is reset to 0. To continue a note through several events (such as a half note in the bass continued during quarter notes and triplets in the treble), the music-code interpreter simply does not initialize the sequence-table pointer for the half note when entering the SOUND routine. The pointer then continues moving along the sequence table for continuity between events.

A problem may develop if a note is so long that the sequence pointer wraps around and starts over from the beginning. This can occur only for durations longer than a whole note and may be handled by backing the pointer up or switching to a different sequence table in which all entries are the same. In fact, it is possible to switch among sequence tables. One table is used for the attack, one for the steady state (sustain), and one for the decay. The steady-state sequence table could

Listing 5: *The advanced waveform-scanning code for the 6502. This version does contain provision for sequencing through multiple waveform tables. The code shown here was developed by Frank Covitz and Cliff Ashcraft.*

```
0200 A000     SOUND:   LDY   #0             ; Y IS ALWAYS ZERO FOR STRAIGHT INDIRECT
0202 A600              LDX   TEMPO          ; KEEP TEMPO COUNTER IN X
0204 B116     SOUND1:  LDA   (SEQPT1),Y     ; LOOKUP WAVEFORM PAGE NUMBER FOR VOICE 1
0206 8504              STA   WAVPT1+2       ; IN WAVEFORM SEQUENCE TABLE
0208 B118              LDA   (SEQPT2),Y     ; VOICE 2
020A 8507              STA   WAVPT2+2
020C B11A              LDA   (SEQPT3),Y     ; VOICE 3
020E 850A              STA   WAVPT3+2
0210 B11C              LDA   (SEQPT4),Y     ; VOICE 4
0212 850D              STA   WAVPT4+2
0214 18       SOUND2:  CLC                  ; ADD FIRST TWO VOICES
0215 B103              LDA   (WAVPT1+1),Y
0217 7106              ADC   (WAVPT2+1),Y   ; AND SEND TO FIRST DAC
0219 6A                RORA
021A 8D00FE            STA   DACA           ; **** START FIRST TIME DIVISON MULTIPLEX
021D A502              LDA   WAVPT1         ; UPDATE WAVEFORM POINTER FOR VOICE 1
021F 650E              ADC   WAVIN1         ;    FRACTIONAL PART
0221 8502              STA   WAVPT1
0223 A503              LDA   WAVPT1+1
0225 650F              ADC   WAVIN1+1       ;    INTEGER PART
0227 8503              STA   WAVPT1+1
0229 A505              LDA   WAVPT2         ; UPDATE WAVEFORM POINTER FOR VOICE 2
022B 6510              ADC   WAVIN2         ;    FRACTIONAL PART
022D 8505              STA   WAVPT2
022F A506              LDA   WAVPT2+1
0231 6511              ADC   WAVIN2+1       ;    INTEGER PART
0233 8506              STA   WAVPT2+1
0235 18                CLC                  ; ADD SECOND TWO VOICES
0236 B109              LDA   (WAVPT3+1),Y
0238 710C              ADC   (WAVPT4+1),Y   ; AND SEND TO SECOND DAC
023A 6A                RORA
023B 8D02FE            STA   DACB           ; **** START SECOND TIME DIVISON MUTIPLEX
023E A508              LDA   WAVPT3         ; UPDATE WAVEFORM POINTER FOR VOICE 3
0240 6512              ADC   WAVIN3         ;    FRACTIONAL PART
0242 8508              STA   WAVPT3
0244 A509              LDA   WAVPT3+1
0246 6513              ADC   WAVIN3+1       ;    INTEGER PART
0248 8509              STA   WAVPT3+1
024A A50B              LDA   WAVPT4         ; UPDATE WAVEFORM POINTER FOR VOICE 4
024C 6514              ADC   WAVIN4         ;    FRACTIONAL PART
024E 850B              STA   WAVPT4
0250 A50C              LDA   WAVPT4+1
0252 6515              ADC   WAVIN4+1       ;    INTEGER PART
0254 850C              STA   WAVPT4+1
0256 CA       SOUND3:  DEX                  ; DECREMENT TEMPO COUNTER
0257 D0AB              BNE   SOUND1         ; REPEAT IF NOTHING SPECIAL
0259 C601              DEC   DUR            ; DECREMENT DURATION COUNTER
025B F00D              BEQ   SOUND5         ; JUMP OUT IF TIMED OUT
025D E616     SOUND4:  INC   SEQPT1         ; INCREMENT SEQUENCE TABLE POINTERS
025F E618              INC   SEQPT2
0261 E61A              INC   SEQPT3
0263 E61C              INC   SEQPT4
0265 A600              LDX   TEMPO          ; RESTORE TEMPO IN X
0267 4C1402            JMP   SOUND2         ; JUMP BACK INTO LOOP
026A 60       SOUND5:  RTS                  ; END OF EVENT, RETURN TO CALLER

0016 0000     SEQPT1:  .BYTE 0,0            ; VOICE 1 WAVEFORM SEQUENCE TABLE POINTER
0018 0000     SEQPT2:  .BYTE 0,0            ; VOICE 2 WAVEFORM SEQUENCE TABLE POINTER
001A 0000     SEQPT3:  .BYTE 0,0            ; VOICE 3 WAVEFORM SEQUENCE TABLE POINTER
001C 0000     SEQPT4:  .BYTE 0,0            ; VOICE 4 WAVEFORM SEQUENCE TABLE POINTER
```



When your Data Demands Security.

ENCODE/DECODE: *THE* Software Security System for CP/M* & TRS-80# DOS

Let's face it, there is information which just isn't meant for everyone who uses or has access to your computer. Consider payroll or tax records. Until now, the only way to secure these and other valued or privileged records meant either "pulling the plug" or locking the discettes in a safe. Who wants to run to the safe each time an update needs to be made? At last a simple, effective and convenient method of data security is available— ENCODE/DECODE.

ENCODE/DECODE is a complete software security system for your micro/mini computer. ENCODE/DECODE can provide both the level of security and privacy you desire without loss of ON-LINE immediate access to data. ENCODE/DECODE is a sophisticated coding program which transforms data stored on disc into coded text which is completely unrecognizable. When it's time to access the file, it is decoded and ready for use. This means that data can be on-line and current with all your other files, yet only the user defined combination can retrieve it.

Multiple Security levels: Using ENCODE/DECODE you can easily maintain several layers of security through the use of separate combinations. This means that each file can have its own 'password' allowing only those with the 'password' access to the file.

ENCODE/DECODE uses a complex coding algorithm which supports over 987,000,000 possible combinations thus making accidental or 'exhaustive search' methods of decoding virtually impossible. Briefly, an encoded data file will appear scrambled and completely unintelligible until you decode it. Both encoding and decoding require the user defined combination.

Uses for ENCODE/DECODE are unlimited. Below are a few examples:

data bases	general ledger	inventory
payroll files	correspondence	accounts payable/ receivable
programs	tax records	
text	mail lists	& more

ENCODE/DECODE is available in two versions. ENCODE/DECODE I provides a level of security suitable for normal use. ENCODE/DECODE II provides enhanced security for the most demanding needs. Both versions come supplied on discette and with a complete user's manual.

ENCODE/DECODE I : $ 50.00
ENCODE/DECODE II: $100.00
manual for above: $ 15.00

Minimal system requirements: 24K CP/M; 16K disc for TRS-80

formats: CP/M 8" SOFT SECTORED, NORTHSTAR CP/M AND TRS-80 DOS

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 344-7596

Technical Hot Line: (217) 384-0847
(answered only when technician is available)

OEM and dealer inquiries invited, overseas orders add $5.00 shipping.

*CP/M REGISTERED TRADEMARK DIGITAL RESEARCH
#TRS-80 TRADEMARK TANDY CORP

Circle 101 on inquiry card

even be coded to cycle through several waveform tables and thus make possible a kind of vibrato. Separate sequence tables could also be used for different playing styles, such as legato, staccato, etc.

Music-Code Interpreter

The music-code interpreter is a program that looks at the encoded score in memory, sets up the parameters for the SOUND routine, and then calls SOUND for each encoded event. A music compiler, when written, translates a high-level music language into the binary-encoded form to be described.

Although such operations are usually done in a music compiler, this interpreter can also compute waveform and sequence tables from instrument specifications encoded in the score. An advantage of this capability is that instrument specifications can sometimes be recomputed on the fly during natural breaks in the music score, if a high-speed Fourier series routine is available.

In order to maximize the flexibility of the system while simplifying the interpreter, the score is encoded into two completely separate *strings* or arrays of 8-bit bytes. One of these is called the *command string*, and it consists of commands to the interpreter such as "Construct an instrument," "Set tempo," "Play a melody segment," "Stop," etc. The other string is called the *note string*, and it

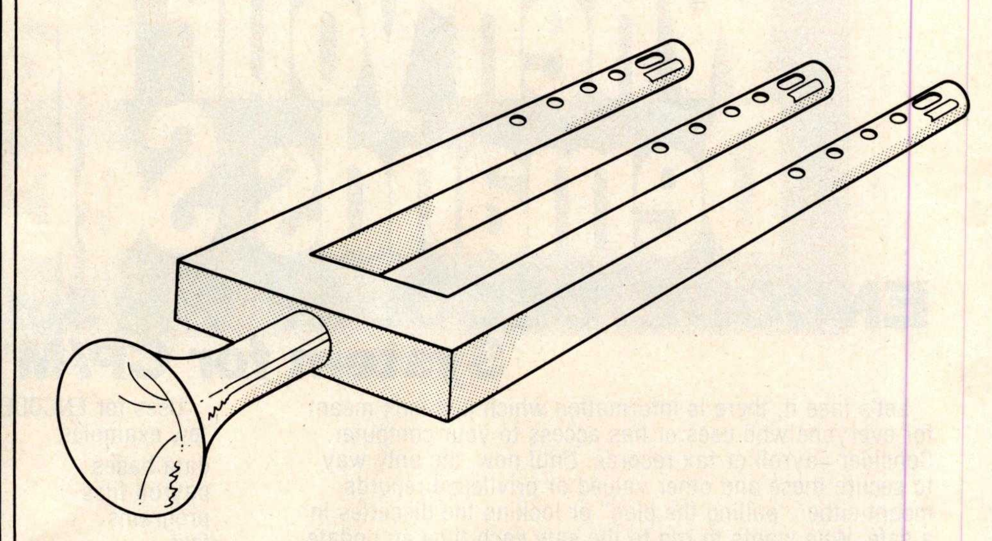


Figure 9a: *Artist's conception of the Glocken-flute, a hypothetical instrument, from a sketch by Cliff Ashcraft.*

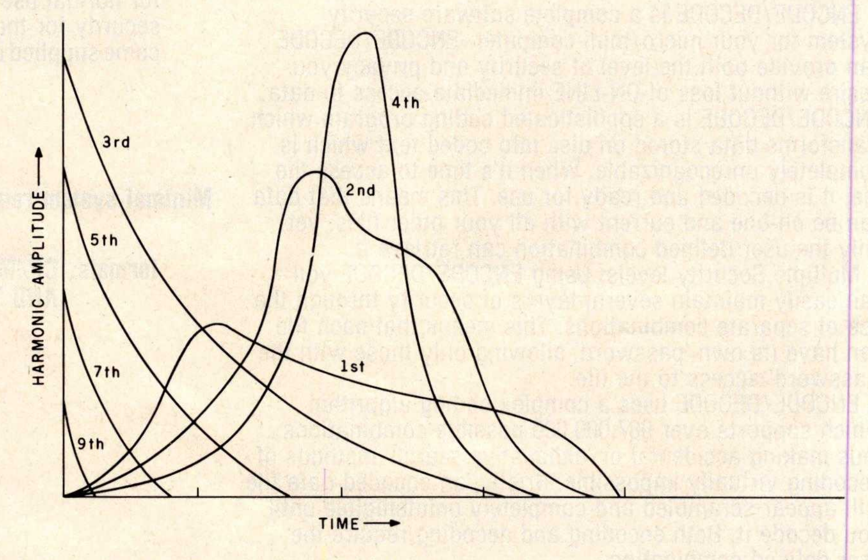
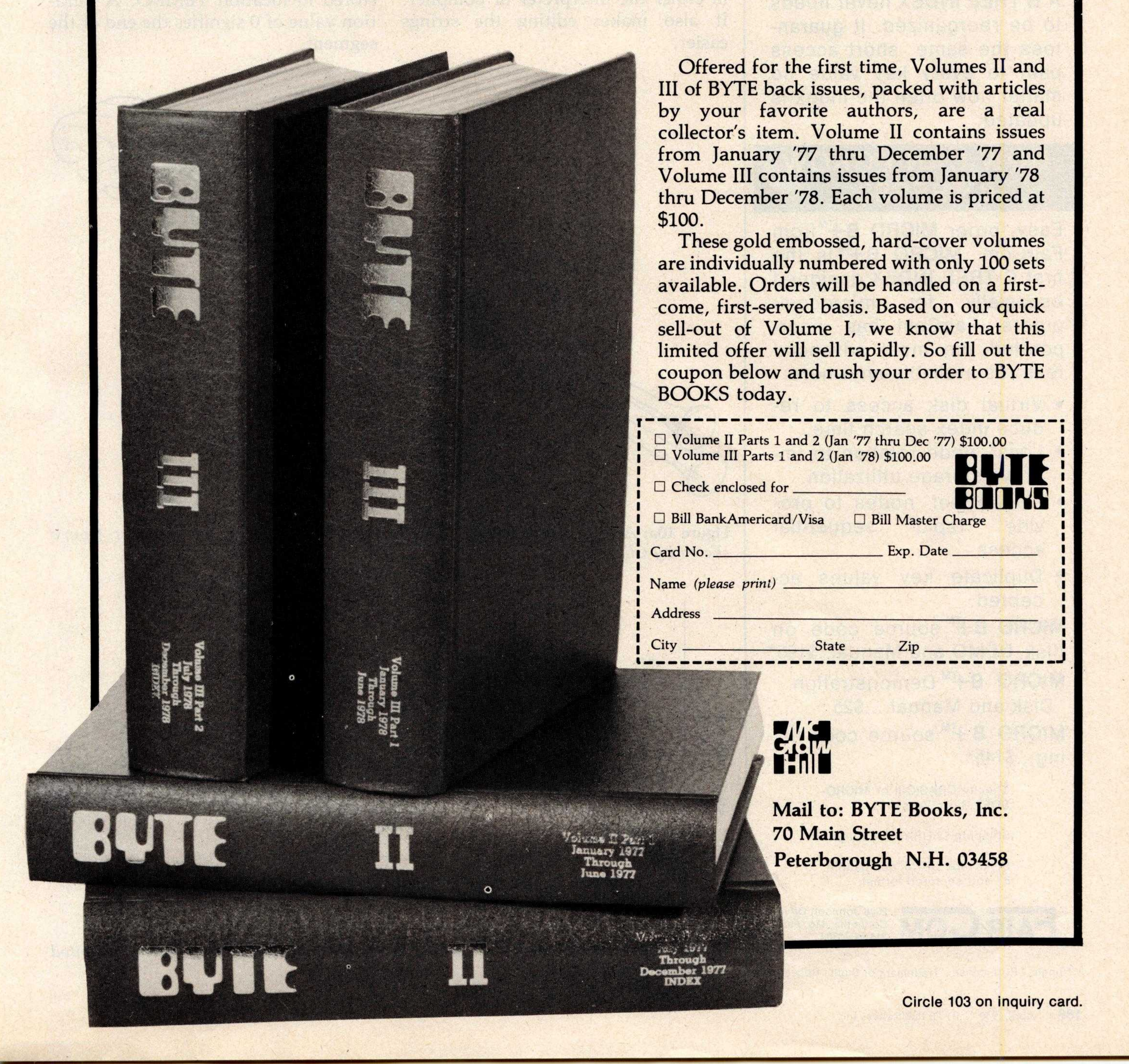


Figure 9b: *Amplitude envelopes for harmonics present in tones produced by the Glocken-flute.*

LIMITED EDITION



Offered for the first time, Volumes II and III of BYTE back issues, packed with articles by your favorite authors, are a real collector's item. Volume II contains issues from January '77 thru December '77 and Volume III contains issues from January '78 thru December '78. Each volume is priced at $100.

These gold embossed, hard-cover volumes are individually numbered with only 100 sets available. Orders will be handled on a first-come, first-served basis. Based on our quick sell-out of Volume I, we know that this limited offer will sell rapidly. So fill out the coupon below and rush your order to BYTE BOOKS today.

☐ Volume II Parts 1 and 2 (Jan '77 thru Dec '77) $100.00
☐ Volume III Parts 1 and 2 (Jan '78) $100.00

BYTE BOOKS

☐ Check enclosed for ____________

☐ Bill BankAmericard/Visa ☐ Bill Master Charge

Card No. ____________ Exp. Date ____________

Name *(please print)* ____________

Address ____________

City ____________ State ______ Zip ____________

McGraw Hill

Mail to: BYTE Books, Inc.
70 Main Street
Peterborough N.H. 03458

Circle 103 on inquiry card.

contains the actual encoded notes.

Functions such as repetition of melody segments (for refrains and the like) are handled by coding multiple commands in the command string to play the same note-string segment. If intervening commands between occurrences have changed the tempo or instrument assignments, the same note-string segment will sound different when it is played again.

This double-string structure gives all of the power of jumps, repeats, and musical subroutines while avoiding the need for return-address saving, symbol tables, or look-ahead in either the interpreter or compiler. It also makes editing the strings easier.

Structure of the Note String

The format of the note string is quite simple, and consists of a sequence of *segments*. Each segment is a section of the score that can be treated as a unit. The command string determines the order in which the segments are actually played. Within a segment is coded a sequence of *events* where each event requires $N+1$ bytes, where N is the number of voices. The first byte of the event gives the duration of the event. The actual duration, in sample periods, is equal to the value of the duration byte multiplied by the current value stored in location TEMPO. A duration value of 0 signifies the end of the segment.

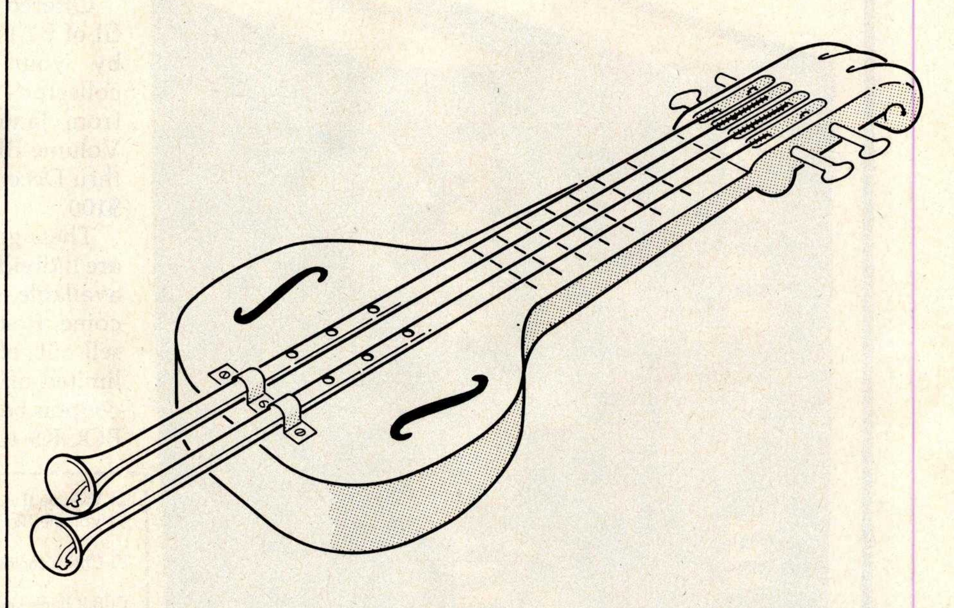


Figure 10a: *Artist's conception of the Blither, another hypothetical instrument, from a sketch by Cliff Ashcraft.*

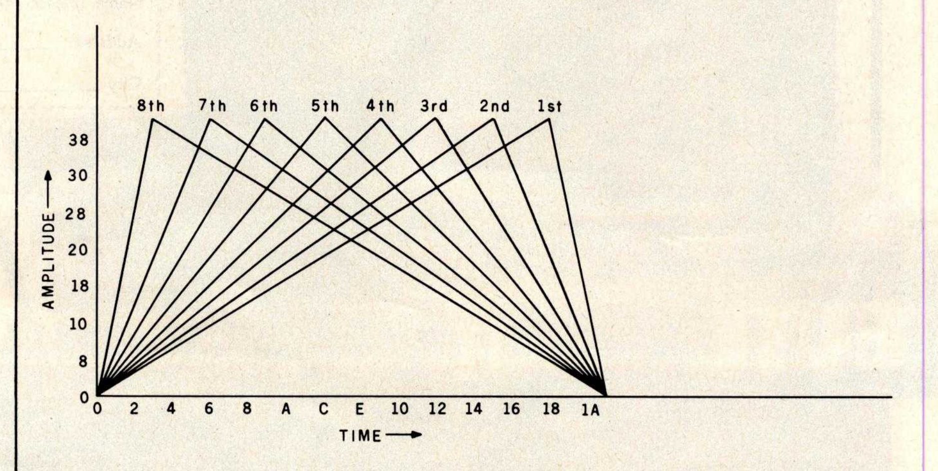


Figure 10b: *Amplitude envelopes for the Blither. Note the unusual symmetry exhibited by the envelopes.*

Succeeding bytes in the event segment give the pitches for each of the *N* voices. A command in the command string can alter *N*, if it is desired to save space when only a couple of voices are required for the segment. The pitch can be specified over a five-octave range that normally goes from C1 (32.7 Hz) to C6 (1046.5 Hz) and contains sixty-one pitch possibilities.

Hexadecimal Op Code	Data Bytes	Operation Description
00 FF		End of command list, return to system monitor.
01 thru 0F	L,H	Play note segment starting at location given by address bytes H,L relative to beginning of note string. Version of SOUND used depends on op code. 01 = original SOUND routine, 02 = advanced SOUND routine.
10	I1,I2,I3,I4	Assign instrument I1, I2, etc to voice 1, voice 2, etc, respectively. Value of I1, I2, etc is page address of waveform-sequence table for the instrument, relative to origin of waveform memory.
11	T	Set TEMPO parameter to T.
12	N	Set number of active voices to N; inactive voices must be assigned to a silent instrument.
13	I,J	Establish pitch offset of J semitones for voice I. J is a signed integer. All offsets are initialized to zero.
14	L,H,...	Go to user-supplied subroutine at absolute address H,L. Command string pointer is pointing to the byte following H.
20	S	Create silent instrument at relative page address S and S + 1
21	S,N, H_i,W,A, W,A, ..., FF, ..., FF	Create a sequence of waveform tables. Start at relative page address S and occupy a total of N pages. H_i is harmonic number, 00 = noise, FF = end of command. W,A group defines a line segment for harmonic H_i; W = ending page address (relative to S) which is abcissa, and A = ending amplitude which is ordinate. Initial endpoint of first line segment for the harmonic is 0,0. W = FF = end of harmonic.
22	A,S,N, D1,D2,...,DN	Create a waveform-sequence table at A for waveform set computed with 21 op code using S and N. D1 is dwell time for waveform 1 in terms of waveform-sequence sample period, D2 is dwell time for waveform 2, etc. The sum of the D parameters should normally be 256.
23	A,S,N, DN,D(N − 1),...,D1	Same as 22, except waveform-sequence is backwards.
24	A,S,N,E	Create a waveform-sequence table at A for waveform set computed with 21 opcode using S and N. E is an exponential "stretch" factor. E = 0 gives a uniform sampling of the N waveforms. Positive E gives an increasing sample rate toward the end of the sequence table, while negative E gives a decreasing sample rate. The exponential scale factor is such that E = 16 gives a two-to-one stretch ratio, E = 32 a four-to-one ratio, etc.
25	A,S,N,E	Same as 24, except waveform sequence is backwards.

Table 1: *Instruction set of the command-code interpreter. The hexadecimal code in the leftmost column invokes the described operation. The op code is followed by one or more data bytes that give parameters for the specified operation. When execution of the interpreter begins, the memory addresses of the origin of the command string, note string, and waveform-table work areas are passed as parameters. All addresses in the command string are given relative to these origins.*

The pitches can also be transposed up or down with an *offset* command for greater range.

Six bits of the pitch-specification byte indicate the pitch within the five-octave range. The remaining two-pitch bits specify how the amplitude envelope is to be handled. Currently, only one bit is used to specify one of the two states *begin note* (reset waveform-sequence pointer) and *continue note* (leave pointer alone), and the other bit is reserved for future use.

Structure of the Command String

The command string is organized as a list of commands that are simply executed in strict sequential order. An individual command consists of a *command code* byte followed by as many *data* bytes as the command needs. Table 1 gives a partial list of available commands. There is plenty of room for expansion as the music package evolves and matures. Many of the commands involve memory addresses such as the beginning of a note-string segment or the addresses of sequence and waveform tables. When the interpreter is entered, the addresses of the origins in memory of the command string, note string, and work area for waveform tables are given; all addresses in the command string are relative to the beginning of these areas. This allows score coding to be machine-independent.

Coding Instrument Definitions

Several of the available commands are used for "constructing instruments," which actually means computing the necessary waveform and sequence tables. The first step in construction is to cause a sequence of waveform tables to be computed by using the command code hexadecimal 21.

The *S* parameter is the page address (relative to the beginning of waveform memory) where the first waveform table will be stored. The *N* parameter is the total number of waveform pages that will be created. This is checked against succeeding line segment data to minimize the effect of errors. *S* and *N* also serve to uniquely identify the waveform sequence for other commands.

In order to simplify coding from

published instrument analyses (such as the quarterly installments of the the "Lexicon of Analyzed Tones" in the *Computer Music Journal*), the command processor will accept harmonic data in a line-segment form. The envelope of each harmonic is defined by a substring of bytes (H_i, *W,A,W,A,...,FF*) where H_i is the actual harmonic number, and each *W,A* pair defines a point on the time-amplitude plane for that harmonic.

A is the amplitude value (an unsigned binary fraction), and *W* is the waveform number, which is proportional to time. The routine will linearly interpolate intermediate amplitude values from the previous *W,A* point to the current *W,A* point. The initial point is always 0,0. Of course, if you wish to directly specify the harmonic amplitude in each waveform table, then consecutive *W*s from 0 to *N* − 1 with corresponding amplitudes could be coded. The end of the *W,A* sequence is denoted by a value for *W* equal to hexadecimal FF. At that point data for another harmonic could follow, or another hexadecimal FF value could be coded to end the waveform-computation command.

Note that if a harmonic amplitude is not specified for a waveform, then its amplitude is assumed to be 0. Presently the system sets the *phase* angles of all harmonics to 90° leading (negative sine waves), which minimizes attack clicks and allows the use of symmetry to double the waveform computation speed. The zeroeth harmonic is actually a source of white noise, which enhances the realism of some instruments and allows limited percussion effects.

Once the waveforms have been computed, the waveform-sequence table must be constructed. Since there are fewer waveforms than the 256-entry capacity of the table, there will be much duplication of entries.

The command indicated by hexadecimal 22 will construct a sequence table with an arbitrary time duration for each waveform. The *A* parameter specifies the memory page number where the sequence table will be stored, and the *S,N* pair identifies the set of waveforms the table is to address. The following *N* bytes gives the "dwell" time in terms of waveform-sequence-sample periods (in terms of audio sample periods each having the value set by TEMPO) for each of the *N* waveforms. Normally the sum of these bytes equals 256 so that the full length of the table addresses all of the waveforms. Using this command, arbitrary nonuniform sampling of the waveform tables may be specified. The command-sequence invoked by hexadecimal 23 is similar, except that the waveform tables are stepped through in reverse order.

For most instruments, the 24 command is appropriate, since only one parameter is needed to define how the sequence table is to be filled. *A*, *S*, and *N* are as before; and *E* is an "exponential stretch" factor. If *E* is set to 0, then uniform sampling is enabled, and the sequence table simply uses a duplication factor of 256/*N*. If *E* is positive, then the sampling density increases (as the duplication factor decreases) toward the end of the table, which means that waveforms are sequenced faster at the end of the note than at the beginning. A negative *E* makes things happen faster at the beginning, which is the usual case for normal instruments.

E is scaled such that a value of

COMMAND STRING		EXPLANATION
Relative Address	Code Bytes	
0000	20 00	Create a silent instrument for inactive voices at page 0 in waveform memory
0002	21 02 1B	Create a sequence of waveform tables for the Blither starting at page 2 in waveform memory, hexadecimal 1B waveforms
0005	01 18 3C 1B 00 FF	Fundamental, two line segments: 0,0 to 18,3C to 1B,0
000B	02 15 3C 1B 00 FF	2nd harmonic, two line segments: 0,0 to 15,3C to 1B,0
0011	03 12 3C 1B 00 FF	3rd harmonic, two line segments: 0,0 to 12,3C to 1B,0
0017	04 0F 3C 1B 00 FF	4th harmonic, two line segments: 0,0 to 0F,3C to 1B,0
001D	05 0C 3C 1B 00 FF	5th harmonic, two line segments: 0,0 to 0C,3C to 1B,0
0023	06 09 3C 1B 00 FF	6th harmonic, two line segments: 0,0 to 09,3C to 1B,0
0029	07 06 3C 1B 00 FF	7th harmonic, two line segments: 0,0 to 06,3C to 1B,0
002F	08 03 3C 1B 00 FF	8th harmonic, two line segments: 0,0 to 03,3C to 1B,0
0035	FF	End of command
0036	24 1D 02 1B F0	Create a waveform sequence table for the Blither at page 1D in waveform memory using an exponential stretch factor of −16.
003B	25 1E 02 1B 10	Create a reverse waveform sequence table at page 1E for the "Anti-Blither" using the same waveforms.
0040	12 02	Set number of active voices to 2.
0042	10 1D 1E 00 00	Voice 1 is Blither, voice 2 is Anti-Blither, voices 3 and 4 are silent.
0047	11 64	Set TEMPO to 100.
0049	02 00 00	Play note string segment at beginning of note string.
004C	02 00 00	Play the scale again.
004F	FF	End of command string, finished.

Table 2a: *An example of a command string. This command string plays a scale on the Blither using the note string of table 2b.*

Settle for More from Your TRS-80

BASIC Compiler.

With TRS-80 BASIC Compiler, your Level II BASIC programs will run at record speeds! Compiled programs execute an average of 3-10 times faster than programs run under Level II. Make extensive use of integer operations, and get speeds 20-30 times faster than the interpreter.

Best of all, BASIC Compiler does it with BASIC, the language you already know. By compiling the same source code that your current BASIC interprets, BASIC Compiler adds speed with a minimum of effort.

And you get more BASIC features to program with, since features of Microsoft's Version 5.0 BASIC Interpreter are included in the package. Features like the WHILE . . .WEND statement, long variable names, variable length records, and the CALL statement make programming easier. An exclusive BASIC Compiler feature lets you call FORTRAN and machine language subroutines much more easily than in Level II.

Simply type in and debug your program as usual, using the BASIC interpreter. Then enter a command line telling the computer what to compile and what options to use.

Voila! Highly optimized, Z-80 machine code that your computer executes in a flash! Run it now or save it for later. Your compiled program can be saved on disk for direct execution every time.

Want to market your programs? Compiled versions are ideal for distribution.* You distribute only the object code, not the source, so your genius stays fully protected.

BASIC Compiler runs on your TRS-80 Model I with 48K and disk drive. The package includes BASIC Compiler, linking loader and BASIC library with complete documentation. $195.00.

*Microsoft royalty information for the sale of programs compiled with BASIC Compiler is available from Microsoft.

muMATH Symbolic Math System

expands your TRS-80 beyond the limits of numerical evaluation to a much higher level of math sophistication.

Symbolic mathematics is muMATH's power. For the first time, algebra, trigonometry, calculus, integration, differentiation and more can be performed on a system smaller than an IBM 370. And in a fraction of the time you could do them manually.

Yet for all its power, muMATH is simple to use.

To perform a differentiation you could enter: ?DIF (A*X ↑ 3 + SIN(X ↑ 2),X);

In almost no time, the computer would reply with: @2*X*COS(X↑ 2) + 3*A*X ↑ 2.

Or to add fractions: ?1/3 + 5/6 + 2/5 + 3/7;
The instantaneous answer: 419/210.

Or to perform a more difficult trigonometric expansion you enter: SIN(2*Y)*(4*COS(X)↑3—COS (3*X) + SIN (Y)*(COS(X+Y+#PI) — COS(X—Y));

Just a few seconds later, the computer replies: @4*SIN(Y)*COS(X)*COS(Y).

muMATH has virtually infinite precision with full accuracy up to 611 digits.

If you use math, you'll find countless ways to save time and effort with muMATH. It's a professional tool for engineers and scientists. A learning tool for students at any level from algebra to calculus.

And if you want to expand your capabilities even beyond the standard muMATH, the option is open. muSIMP, the programming language in which muMATH is written, is included in the muMATH package. A superset of the language LISP, muSIMP is designed especially for interactive symbolic mathematics and other artificial intelligence applications.

muMATH and muSIMP were written by The Soft Warehouse, Honolulu, Hawaii. Priced at $74.95, the package includes muMATH, muSIMP and a complete manual. It requires a Model I TRS-80 with 32K and single disk. muMATH for the Apple II Computer will be available later this year.



You can buy muMATH and BASIC Compiler at computer stores across the country that carry Microsoft products. If your local store doesn't have them, call us. 206-454-1315. Or write Microsoft Consumer Products, 10800 Northeast Eighth, Suite 507, Bellevue, WA 98004.



Circle 107 on inquiry card.

NOTE STRING Relative Address	Code Bytes	EXPLANATION
0000	40 19 0D	Blither plays quarter note C3, Anti-Blither plays C2, envelope starts at beginning.
0003	40 9B 8F	D3 and D2, continue envelope for tied notes.
0006	40 9D 91	E3 and E2, tied to first two notes
0009	40 1E 12	F3 and F2, restart envelope.
000C	40 A0 94	G3 and G2, continue envelope.
000F	40 A2 96	A3 and A2, continue envelope.
0012	40 24 18	B3 and B2, restart envelope.
0015	80 25 19	C4 and C3, half notes, tied to previous notes.
0018	00	End of note segment, return to command string.

Table 2b: *An example of a note string that plays a scale on the Blither, the instrument shown in figure 10.*

+16 (or −16) will give a two-to-one difference in duplication factor between the end and the beginning of the sequence table. A value of 32 gives a four-to-one difference, and so on. The command processor is smart enough so that all of the waveforms are used, regardless of the value of *E*. The 25 command is similar except that the waveform tables are sequenced backward.

Note that, by using different sequence-table commands and different parameter values, a number of different sequence tables may be created using the same waveform set. This gives a variety of different sounding instruments (it is often surprising how different sounding they are) with only 256 bytes required per additional instrument. There are doubtless many other methods of specifying waveform-sequence tables (such as provision for cycling waveforms to achieve vibrato), and there is ample room for expansion.

Probably the easiest way to verify an understanding of the preceding is to follow through an instrument-definition example. For simplicity, the Blither, whose analysis is shown in figure 10b, will be used. Table 2 gives a command sequence that can be used to define the instrument, assign it to a voice, and play a note-string segment with it.

Results

There are many other aspects of the interpreter too numerous to explain here. In general, the system gives very good results, even at the 6.9 kHz sample rate that the unoptimized SOUND routine provides. Over two dozen pieces of widely varying content have been coded by Frank and Cliff and played to audiences. The biggest hit has been "Dueling Banjos" from the movie *Deliverance*, which, after several iterations of the instrument definitions, produces quite realistic guitar and banjo sounds.

With relatively little effort, instrument definitions for cello, baritone horn, clarinet, mandolin, flute, zither, and even steel-drum band have been coded as well, and integrated into appropriate (and not so appropriate) musical scores. The piano has proved to be very difficult to imitate passably, but progress is being made by defining each octave as a separate instrument. The development of a sound-analysis program that runs on a 6502 microprocessor and produces data acceptable to the music interpreter will greatly aid the coding of additional existing instruments.

The biggest complaint from listeners has been the small but audible background-noise level which results from waveform-pointer truncation and, to a lesser extent, from waveform-table switching. In contrast, users of the system who attempt to encode melodies seem bothered most by the limited high-frequency response, which restricts the notes playable by instruments that have

rich harmonic spectra. By orchestrating the piece properly, it is possible to mask these shortcomings to some degree.

Evolution into a Non-Real-Time System

If the goal is production of music to be stored on audio media, it is possible to take the synthesizing process out of real time and thereby obtain a much higher-quality result. In particular, the sample rate may be made as high as desired and the noise level made inaudible (compared to the noise inherent in the recording medium) by eliminating the shortcuts necessary for real-time output. Multiplication and division can also be admitted if needed, and new features, such as a digital filtering, added.

The usual complaint about non-real-time systems is the lack of immediate audible feedback, which impedes the composition process. However, with this system, composition can be done in real-time mode with all the features available; then the music can be realized in non-real-time mode for a perfectly clean-sounding final result. This is not unlike common practice in word-processing centers (computerized typing pools) where a high-speed, dot-matrix proof printer is used for rapid draft output and a much slower letter-quality printer is used for the final copy.

In the past, a non-real-time music synthesis system was simply not practical on personal-computer hardware because the required volume of high-speed mass storage was unavailable. However, many of the systems entering today's market have the necessary disk-storage capacity and transfer rate to do an excellent job. It goes without saying that a system equipped with a hard disk drive is more than adequate, and a fair number of manufacturers have hard disk systems available for personal and small business computers. The typical storage capacity of 10 megabytes would hold in excess of 5 minutes of 12-bit sound at a 20 kHz sample rate, adequate for a typical record-album cut.

However, it is surprising to many people that floppy disks are also practical for music playback and, of course, they cost much less than a hard disk. An ordinary 8-inch, single-sided, single-density floppy-disk drive can attain an average transfer rate of 20 K bytes per second, and a disk in that drive can hold 315 K bytes of data if it is formatted properly. This translates into a 13.3 kHz sample rate with 12-bit samples, and into about 15 seconds of music per disk. With two drives and a carefully written waveform-sample-playback program, the idle disk drive can be manually loaded while the other is being read and thereby attain practically unlimited piece durations. Double-density disks could double the sample rate, and double-sided disks could double the duration per disk to 30 seconds of 25 kHz sample-rate, 12-bit sound!

The problem up until now has actually been the typical floppy-disk controller, which requires program intervention to transfer each byte of data to or from the disk. Newer disk controllers use direct memory access (DMA) for data transfers, which is a virtual necessity with the increasingly popular double-density formats anyway. With a DMA-type disk controller, it becomes possible to use an ordinary programmed-I/O D/A converter, although a D/A converter that employs direct-memory-access I/O transfer could simplify playback-programming further.

Conclusion

By now it should be apparent that a simple D/A converter really is the ultimate audio-output peripheral for a computer. Any kind of sound can be synthesized; it is simply a matter of programming. Future high-speed processors and reasonably priced hard disks will allow software systems having both a real-time "draft mode" and a high-quality "final mode" to be implemented on personal-computer hardware, thus giving the best of both worlds. This will in turn give the capability of professional-quality music synthesis to anyone with the creative desire to do it.■

The music interpreter that has been described is available from Micro Technology Unlimited, POB 4596, Manchester, NH 03108, in versions for the Commodore PET and for the KIM-1, SYM-1, and AIM-65 processors. Contact Micro Technology Unlimited about arrangements for Apple II, Atari, and Ohio Scientific machines. An audio demonstration tape of the system is available for $5.00. Also available is an 8-bit audio D/A converter with 6-pole 3.5 kHz filter and power amplifier.

The programs of listings 4 and 5 and the driving software described in the text were developed and coded by Frank Covitz and Cliff Ashcraft. Their addresses are:

Frank Covitz
Deer Hill Rd
Lebanon NJ 08833

Cliff Ashcraft
150 Mercer St
Hightstown NJ 08520..

References

1. Chamberlin, Hal, "A Sampling of Techniques for Computer Performance of Music," September 1977 BYTE, pages 62 thru 83. (Reprinted in *The BYTE Book of Computer Music*, edited by Christopher P Morgan, BYTE Books, 1979, pages 47 thru 63).
2. Mathews, Max, *The Technology of Computer Music*, MIT Press, Cambridge, MA 1969.
3. Moorer, J, and J Grey, "Lexicon of Analyzed Tones: The Trumpet." *Computer Music Journal*, volume II, number 2, 1978, page 23.
4. Moorer, J, and J Grey, "Lexicon of Analyzed Tones: The Cello." *Computer Music Journal*, volume I, number 1, 1977, page 4.
5. Moorer, J, and J Grey, "Lexicon of Analyzed Tones: The Clarinet." *Computer Music Journal*, volume I, number 3, 1977, page 12.
6. Oppenheim, A and R Shafer, *Digital Signal Processing*, Prentice-Hall, Englewood Cliffs NJ 1975.
7. Patterson, Blake R, "Musical Dynamics" *Scientific American*, November 1974, pages 79 thru 95.

MULTI-USER OASIS HAS THE FEATURES PROS DEMAND. READ WHY.

(THEN COMPARE.)

Computer experts (the pros) usually have big computer experience. That's why when they shop system software for Z80 micros, they look for the big system features they're used to. And that's why they like Multi-User OASIS. You will too.

DATA INTEGRITY: FILE & AUTOMATIC RECORD LOCKING

The biggest challenge for any multi-user system is co-ordinating requests from several users to change the same record at the same time.

Without proper co-ordination, the confusion and problems of inaccurate or even destroyed data can be staggering.

Our File and Automatic Record Locking features solve these problems.

For example: normally all users can view a particular record at the same time. But, if that record is being updated by one user, automatic record locking will deny all other users access to the record until the up-date is completed. So records are always accurate, up-to-date and integrity is assured.

Pros demand file & automatic record locking. OASIS has it.

SYSTEM SECURITY: LOGON, PASSWORD & USER ACCOUNTING

Controlling who gets on your system and what they do once they're on it is the essence of system security.

Without this control, unauthorized users could access your programs and data and do what they like. A frightening prospect isn't it?

And multi-users can multiply the problem.

But with the Logon, Password and Privilege Level features of Multi-User OASIS, a system manager can specify for each user which programs and files may be accessed—and for what purpose.

Security is further enhanced by User Accounting—a feature that lets you keep a history of which user has been logged on, when and for how long.

Pros insist on these security features. OASIS has them.

EFFICIENCY: RE-ENTRANT BASIC

A multi-user system is often not even practical on computers limited to 64K memory.

OASIS Re-entrant BASIC makes it practical.

How?

Because all users use a single run-time BASIC module, to execute their compiled programs, less memory is needed. Even if you have more than 64K, your pay-off is cost saving and more efficient use of all the memory you have available—because it services more users.

Sound like a pro feature? It is. And OASIS has it.

AND LOTS MORE...

Multi-User OASIS supports as many as 16 terminals and can run in as little as 56K memory. Or, with bank switching, as much as 784K.

OASIS IS AVAILABLE FOR: Altos; Bell Controls; Billings; Compucorp; Cromemco; Corvus; Delta Products; Digital Group; Digital Microsystems; Dynabyte; Godbout, IBC; Industrial Microsystems; Konan; Micromation; Micropolis; North Star; Onyx; SD Systems; Tarbell; Thinkertoys; TRS 80 Mod. II; Vector Graphic Vorimex; X Comp; and others.

Multi-Tasking lets each user run more than one job at the same time.

And there's our BASIC—a compiler, interpreter and debugger all in one. An OASIS exclusive.

Still more: Editor; Hard & Floppy Disk Support; Keyed (ISAM), Direct & Sequential Files; Mail-Box; Scheduler; Spooler; all from OASIS.

Our documentation is recognized as some of the best, most extensive, in the industry. And, of course, there's plenty of application software.

Put it all together and it's easy to see why the real pros like OASIS. Join them. Send your order today.

MAKES MICROS RUN LIKE MINIS.

OASIS

CIRCLE WHAT YOU WANT

Product	Price with Manual	Manual Only
OPERATING SYSTEM (Includes: EXEC Language; File Management; User Accounting; Device Drivers; Print Spooler; General Text Editor; etc.) SINGLE-USER MULTI-USER	$150 350	$17.50 17.50
BASIC COMPILER/ INTERPRETER/DEBUGGER	100	15.00
RE-ENTRANT BASIC COMPILER/INTERPRETER/ DEBUGGER	150	15.00
DEVELOPMENT PACKAGE (Macro Assembler; Linkage Editor; Debugger)	150	25.00
TEXT EDITOR & SCRIPT PROCESSOR	150	15.00
DIAGNOSTIC & CONVERSION UTILITIES (Memory Test; Assembly Language; Converters; File Recovery; Disk Test; File Copy from other OS; etc.)	100	15.00
COMMUNICATIONS PACKAGE (Terminal Emulator; File Send & Receive)	100	15.00
PACKAGE PRICE (All of Above) SINGLE-USER MULTI-USER	500 850	60.00 60.00
FILE SORT	100	15.00
COBOL-ANSI '74	750	35.00

Order OASIS from:
Phase One Systems, Inc.
7700 Edgewater Drive, Suite 830
Oakland, CA 94621
Telephone (415) 562-8085
TWX 910-366-7139

NAME__________
STREET (NO BOX #)__________
CITY__________
STATE______ ZIP______
AMOUNT $______
(Attach system description; add $3 for shipping; California residents add sales tax)
☐ Check enclosed ☐ VISA
☐ UPS C.O.D. ☐ Mastercharge
Card Number__________
Expiration Date__________
Signature__________

Program Those 2708s!

Robert Glaser
3922 Algiers Rd
Randallstown MD 21133

Erasable programmable read-only memories (EPROMs) can be used to great advantage in many microcomputer applications. One of the stumbling blocks to more widespread hobbyist use of EPROMs has been the difficulty of programming them. Several companies offer programming services, but this can be time-consuming as well as expensive.

One of the first EPROMs to become available was the 1702 device, which is structured as 256 words by 8 bits. This EPROM is indeed difficult to program. All of its address and data lines must be switched at 50 V levels, requiring a multitude of level-shifting transistors, in addition to the timing logic. Although it is possible to construct a programmer for the 1702, it is certainly not simple.

Salvation for the hobbyist came with the Intel 2708 EPROM. This device sports 1 K words by 8 bits of memory, four times the capacity of the 1702. It requires power supplies of +5 V, +12 V, and −5 V. For read operation, all that is required is to supply the address lines with the desired memory address, and select the individual EPROM device by grounding the chip-select input. The outputs appear on the data lines.

The greatest advantage of this 2708-type memory is its program-

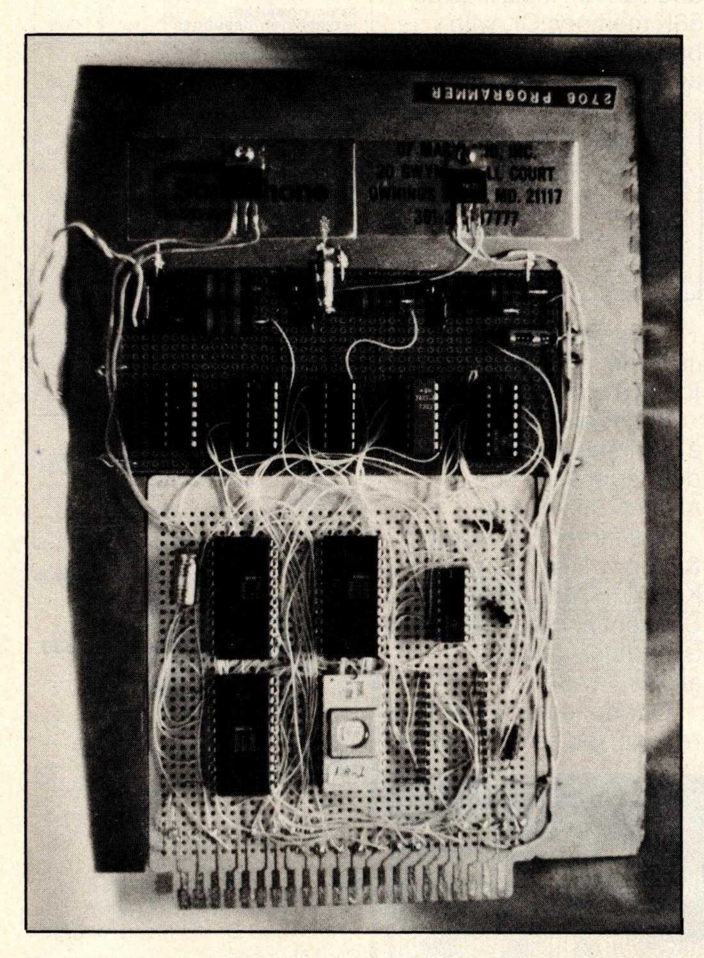


Photo 1: *Front side of the EPROM programming circuit board. Components may be identified from diagram of figure 4. A Radio Shack 44-pin card forms the base of the board, which has had other sections added to it. TO-220 packages at top are voltage regulators.*

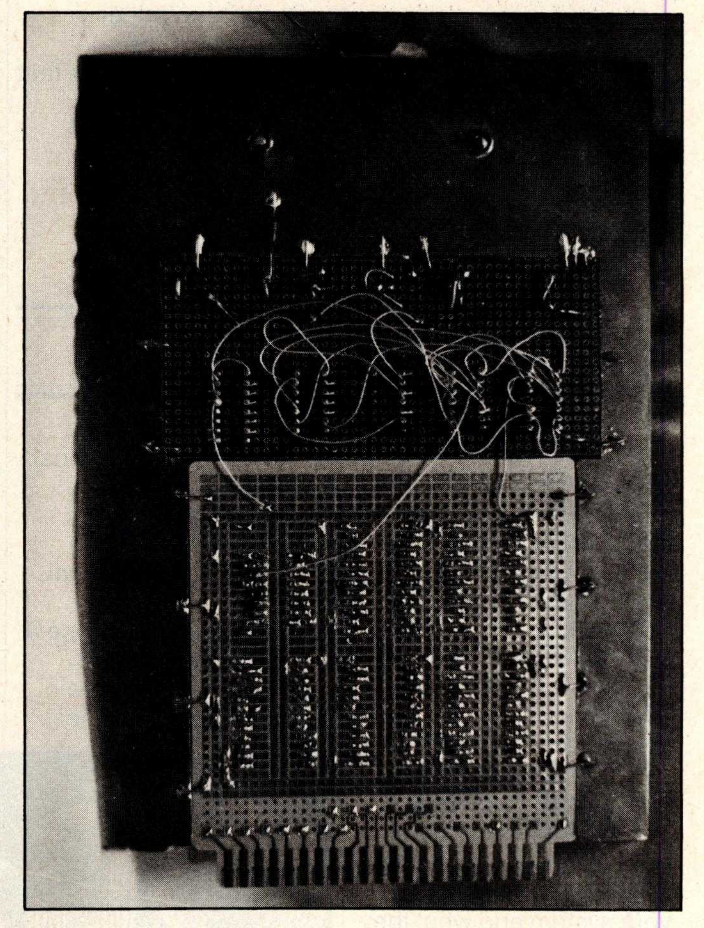


Photo 2: *The back side of the EPROM programming circuit board. The author wishes to thank Marc Leavey MD, WA3AJR for performing the photography.*

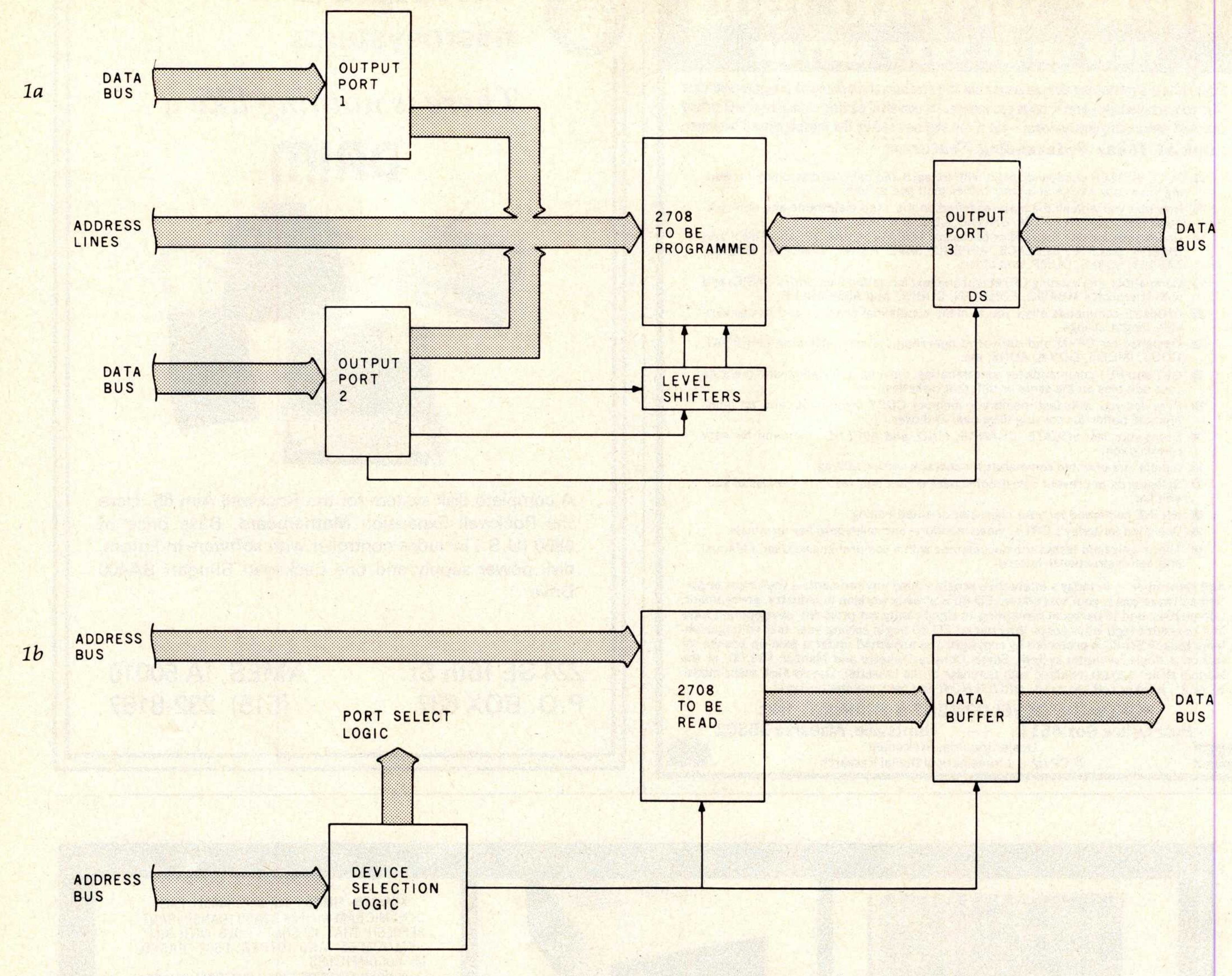


Figure 1: *Block diagrams of the 2708 EPROM programming circuit (1a) and 2708 reading circuit (1b).*

ming simplicity. All address and data lines need only be supplied with transistor-transistor logic (TTL) voltage levels. Two lines must be pulsed at nonTTL voltage levels. The write-enable line must be raised to +12 V, and the program pulse rises to +26 V.

After erasure with an ultraviolet lamp, all bits of the 2708 are in the logic 1 state. Programming consists of selectively changing the 1s to 0s. After the write-enable line is raised to +12 V, each byte is set up by applying the address and data information to the proper pins, and then pulsing the program input. The proper method is to sequence through all of the addresses many times. Each run through all addresses is called a *program loop*. The specifications of the 2708 device call for the number of program loops, multiplied by the duration of the program pulse, to form a total pulse time of at least 100 ms.

Microcomputer 2708 Programming

A simple way to accomplish the programming is to utilize a microcomputer system. With a small program routine, several output ports and some level shifters, it is easy to program the EPROM. Figure 1 shows the block diagram of the circuit I use in my 8080 system for the programming operation. Output port 1 and part of output port 2 supply the address to the 2708 device to be programmed. Output port 3 feeds the desired data to the 2708. Part of output port 2 and some level shifters provide the programming pulses for the device.

Each output port is an 8212 latch. The 8212 device is a general purpose I/O (input/output) port. The pin connections are shown in figure 2. The output of the latch is 3-state. If the mode input is high, the outputs are always enabled. When the device is selected by placing a low on $\overline{DS1}$ (active-low, device-select line) and a high on DS2 (active-high line), whatever data is present at the data input (DI) lines is latched and appears at the data output (DO) lines.

If the mode input is low, the outputs are in the high-impedance state until the device is selected. In this case, the data is latched by a signal on the strobe line. The 8212 places little loading on the data bus, and is quite suitable for the output ports used in this project.

TRS-80® CP/M® & CBASIC® BUSINESS SOFTWARE

All MOD II CP/M's are ***not*** created equal . . .
Find out why ours is the **Better Business Buy!**

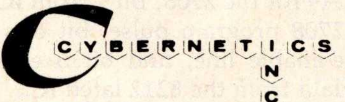
Model I CP/M (rel. 1.5) $150.00
Model II CP/M (rel. 2.0) 250.00
CBASIC 95.00

APH (Automated Patient History)...... 175.00
RESIDENTIAL PROPERTY ANALYSIS system 300.00

The Genuine Article:
Osborne & Assoc. CBASIC source programs—
O&A **Payroll** w/Cost Accounting..... $250.00
O&A **Accts. Rec./Accts. Payable** ... 250.00
O&A **General Ledger** w/Cash Journal. 250.00
O&A CBASIC books for above (each).... 20.00

Send 30¢ SASE for CP/M Users Group software list & free "CP/M Primer".

® TRS-80 is a registered trademark of Radio Shack, a Tandy company
® CP/M is a registered trademark of Digital Research
® CBASIC is a registered trademark of Software Systems



(714) 848-1922

8041 NEWMAN AVENUE • SUITE 208 • HUNTINGTON BEACH, CALIFORNIA 92647



TEC 510

$750*

DISPLAY
- 25 lines by 80 characters, 12" diagonal display.
- Reverse video, blinking, underline, reduced intensity, protected fields, blank security fields.
- Upper and lower case — 95 displayable ASCII characters.
- 6x8 dot matrix character format (displays descending tails for lower case characters).

KEYBOARD
- Typewriter layout. Sixty keys with imbedded numeric keypad.
- Repeat key. Cursor control keys.

INTERFACE
- Transmit character, line, partial page, page, or unprotected data only.
- Serial interface, RS232C, 110 – 9600 baud, full or half duplex.

GENERAL
- Cursor up, down, left, right, home, return, load, and read.
- Software controlled keyboard lock/unlock.
- Clear screen/clear memory, page or scroll mode, self test.
- Advanced LSI design uses only 18 integrated circuits.
- Compact, lightweight (16"w x 13.5"h x 20"d, 33 lbs.)

TO ORDER
- Send certified check or money order. C.O.D.'s require a 15% deposit.
- Personal checks require two weeks to clear.



MICROMAIL • BOX 3297 • SANTA ANA, CA 92703
(714) 731-4338

* In Quantities.



on computers, peripherals, software and other Radio Shack® products.

NO ONE CAN GIVE YOU A BETTER DEAL ON TRS-80 COMPUTERS!!

OUR Radio Shack® Merchandise is New and covered by Radio Shack® Warranties

WE PAY Domestic U.P.S. Shipping & Insurance on minimum orders

NO TAXES are collected on out-of-state Shipments

TOLL FREE Order Number

OPEN 8:00 a.m. to 6:00 p.m., Central Time, Monday through Friday; 9:00 a.m. to 6:00 p.m., Saturday

Offered Exclusively By

Pan American Electronics
INCORPORATED

A

Radio Shack®
AUTHORIZED SALES CENTER

1117 CONWAY MISSION, TEXAS 78572
TOLL FREE ORDER NUMBER 800/531-7466
VISA® TEXAS AND MAIN TELEPHONE NUMBER 512/581-2765



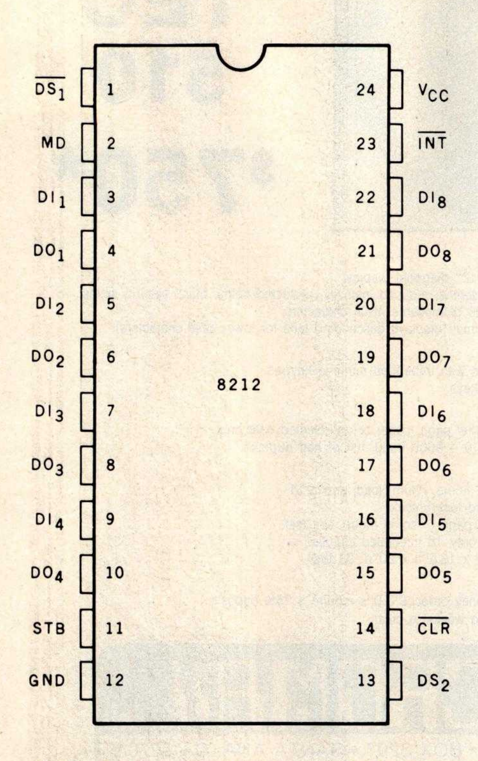


Figure 2: *Pin configuration of the 8212 integrated circuit. This device is an 8-bit I/O port latch. Three of them are used in the EPROM programming circuit.*

Number	Type	+5 V	GND	−5 V	+12 V
IC1	8212	24	12	—	—
IC2	2708	24	12	21	19
IC3	8212	24	12	—	—
IC4	8212	24	12	—	—
IC5	7404	14	7	—	—
IC6	7408	14	7	—	—
IC7	7404	14	7	—	—
IC8	7427	14	7	—	—
IC9	2708	24	12	21	19
IC10	8T97	16	8	—	—
IC11	8T97	16	8	—	—
IC12	7812	—	—	—	—
IC13	7805	—	—	—	—

Table 1: *Power supply connections for integrated circuits used in circuit of figure 3. IC12 and IC13 are voltage regulators.*

The schematic diagram of the programmer circuit is shown in figure 3. The 8212s IC1 and IC4 provide the address for the 2708 to be programmed. The mode input of these 8212s is high, causing the output lines to be always active. The 8212 IC3 provides the data byte to the 2708. The mode line is low, causing the outputs to be in the high-impedance state until the chip is selected. The reason for this is that the 2708 data lines are outputs until the 2708 is placed into the program mode.

Under program control, the 8212 latch IC3 provides data to the 2708. IC1 supplies the low 8 address lines, and is set up for hexadecimal output-port address 14. IC4 is at hexadecimal output port address 15.

Bits 0 and 1 (DO_1 and DO_2 on the output of IC4) supply address bits A8 and A9 for the 2708. Bit 7 from IC4 is the 2708 program pulse, bit 6 is the write-enable line, and bit 5 enables the data from the 8212 latch IC3. IC3 is set up for hexadecimal output-port address 16. The system reset pulse clears IC4, placing critical signals in the off mode.

To program a 2708, the integrated circuit package is placed into the program socket, and the circuit board is inserted into the 8080 mainframe. The 8080 system may then be powered up, and the program run. The 26 V power supply should be turned on just prior to supplying the address to the program.

It is important not to apply the high voltage before the system is powered up and reset. After programming, the sequence should be followed in reverse. The 26 V supply should be turned off, the computer turned off, the board unplugged, and the 2708 removed.

To read what has been written into EPROM, the device is plugged into the *read* socket. Hexadecimal address 0000 is used. If you already have an EPROM board which can read 2708s, then this portion of the circuit can be deleted. The inhibit line prevents the 2708 from being selected.

Construction

Construction will depend upon your particular system. My 8080-based system was built using 44-pin edge connectors. This permits the use

Text continued on page 206

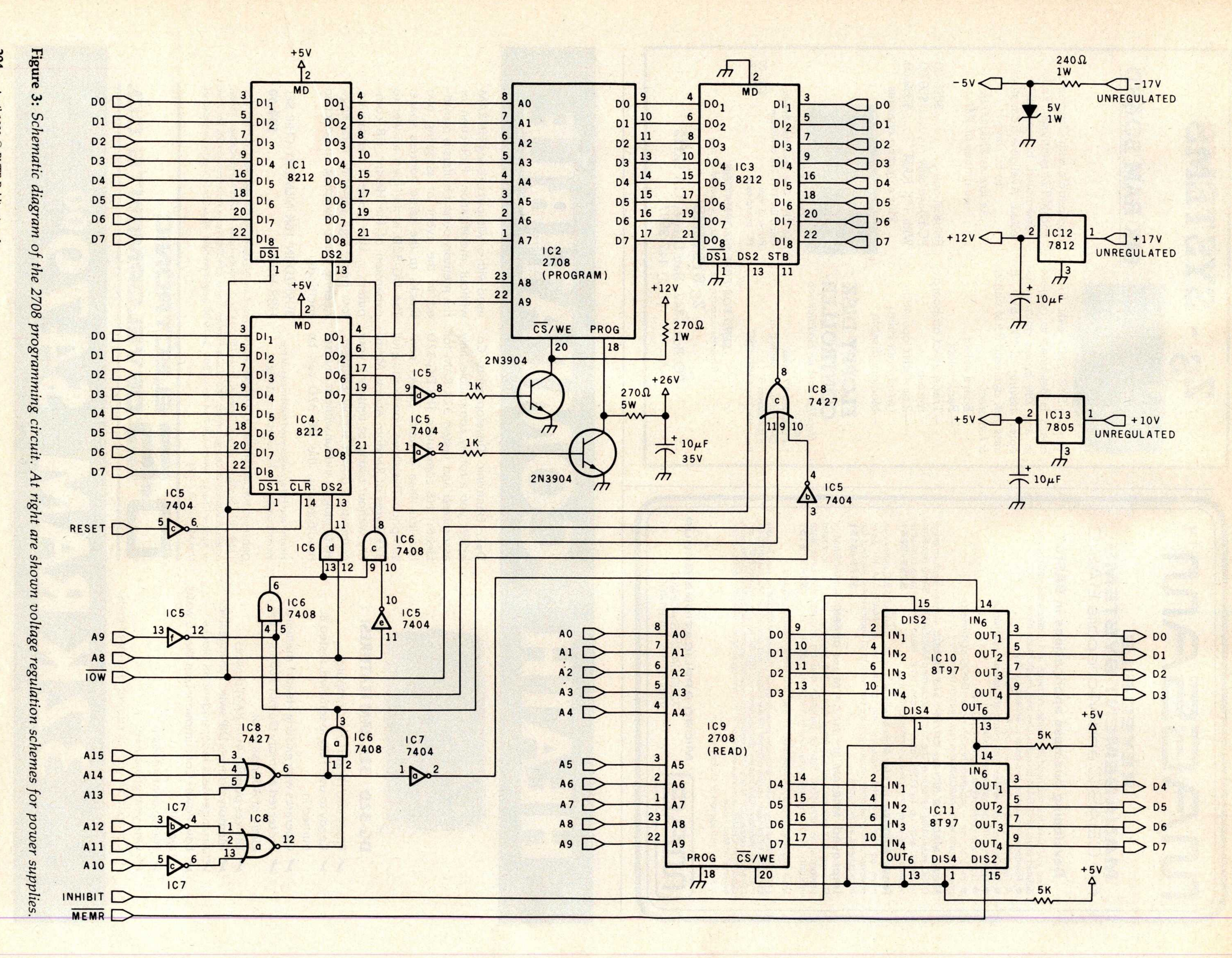


Figure 3: *Schematic diagram of the 2708 programming circuit. At right are shown voltage regulation schemes for power supplies.*

Circle 118 on inquiry card.

GENERAL LEDGER
PAYROLL
ACCOUNTS RECEIVABLE & PAYABLE

Flexible and sophisticated business software that is among the highest quality on the market. Originally developed by OSBORNE & ASSOCIATES and rapidly becoming a standard. Our service is support. We will send you these programs with the proper I/O and CRT specific subroutines for your hardware configuration. Get back to business and leave the programming to us. Include hardware description with order.

- Accounts Receivable and Payable 145.00
- Payroll (California) 145.00
- Non California state tax calculations (please inquire) 15-250.00
- General Ledger 145.00
- Multiple profit center option for G/L 25.00
- Manuals (each) 20.00

All programs in CBASIC under CP/M (includes source)

UTILITIES

- DOS MOVER for NORTH STAR. Moves DOS and BASIC anywhere you want it. (i.e., from 2A00 to 0000) 35.00
- ALS-8 MOVER on North Star Disk 35.00

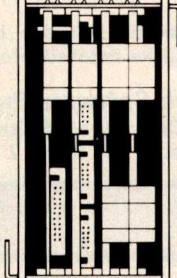
Synergetic Computer Products
3885 Magnolia Drive • Palo Alto, CA 94306
(415) 856-6049
Visa • Mastercharge • COD • Certified Check
CP/M is a trademark of Digital Research

Circle 119 on inquiry card.

DEC LSI-11 Components

Dependable service at discount prices

Domestic and Export



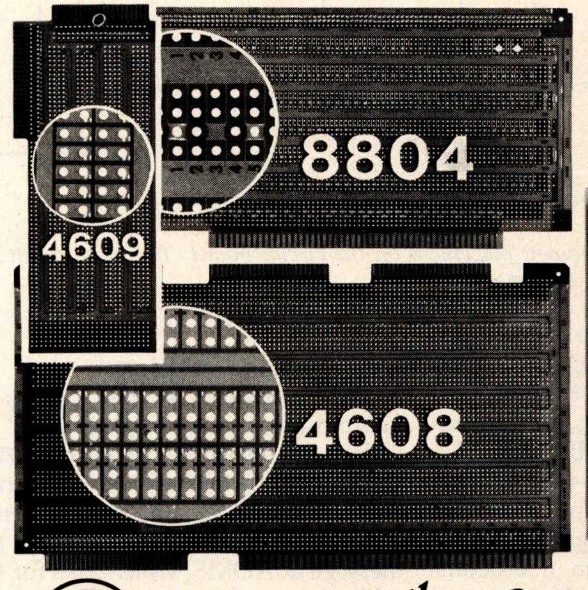
Mini Computer Suppliers, Inc.
25 Chatham Rd., Summit, N.J. 07901
Since 1973
(201) 277-6150 Telex 13-6476

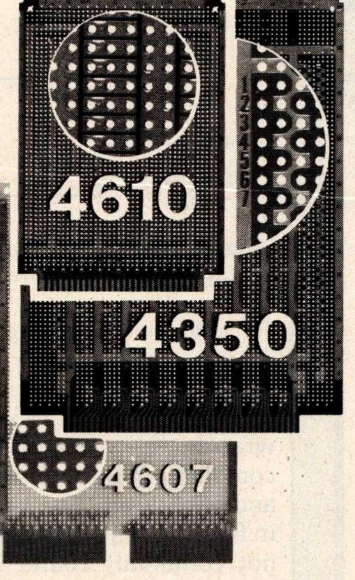
©Mini Computer Suppliers, Inc. 1979



BUILD YOUR COMPUTER BREADBOARDS & INTERFACES FASTER AND EASIER WITH NEW VECTOR PLUGBORDS

EASY TO USE! COST EFFECTIVE! CLEAN HOLES!





4610 Series - For STD-BUS-WW, solderable and unpatterned models

4608 Series - For Intel/National SBC/BLC 80-WW/solderable, or unpatterned

8804 Series - For S100 - 5 models available

4607 - For DEC LSI 11/PDP8-11, Heath H-11

4609 - For Apple II, SuperKim, Pet Commodore with Expandamem

4350 - For TI 980 Computer



12460 Gladstone Ave., Sylmar, CA 91342 (213) 365-9661 TWX (910) 496-1539
Available through Distributors or Factory Direct if not available locally.

74801

Circle 120 on inquiry card.

IC13 7805 | IC12 7812 | IC6 7408 | IC5 7404 | IC7 7404 | IC8 7427 | IC11 8T97 | IC4 8212 | IC3 8212 | IC10 8T97 | IC1 8212 | IC2 2708 (PROGRAM) | IC9 2708 (READ)

Figure 4: *Diagram of component placement on the circuit board. The board itself has been assembled from three sections.*

Text continued from page 202:

of inexpensive Radio Shack circuit boards. For the more conventional S-100 bus configuration, many wire-wrap boards are available. I used a combination of point-to-point wiring and wire-wrap. The layout is shown in figure 4. The only required voltage not commonly found in microcomputer systems is the +26 V. I connect a suitable power supply to the board when it is needed.

Programming Program

The program is set up as a subroutine (shown in listing 1). To satisfy the requirements for the 2708, I chose to go through 256 program loops, each lasting at least 0.5 ms. The subroutine MSG prints the message at ADMS, which asks for the address in memory where the data to be programmed into the 2708 is to be found. It is assumed that 1 K bytes of

Circle 124 on inquiry card.



OSBORNE BUSINESS SOFTWARE

in CBASIC2 *or* CROMEMCO 16K BASIC

★ *features* ★

- Four Complete Packages---
  - General Ledger
  - Accounts Receivable
  - Accounts Payable
  - Payroll with Cost Accounting
- Strong support from Osborne Manuals
- CBASIC2 runs under CP/M or under CDOS version 1.07 on Cromemco computers
- 16K BASIC runs on Cromemco computers
- Cursor addressing routines for Hazeltine, Lear Siegler and Cromemco (Beehive) Terminals
- Source Codes and Installation Instructions provided along with disks
- Automatic Command Start-up
- Easy to apply to all of your business and systems needs

★ *hardware required* ★

- One or more 8" or 5" Floppy Drives
- CRT with cursor addressing
- 132-Column Printer

$95 *per package*

TO ORDER:
Add $5 for shipping
Calif add 6-1/2% Sales Tax
CREDIT CARDS ACCEPTED

• DEALER INQUIRIES INVITED •

MICAH'S PRODUCTS OF DISTINCTION

- OSBORNE BUSINESS SOFTWARE (in CBASIC2 & 16K)
- CBIOS (CP/M for Cromemco Computers)
- MICROPLOT (Versatile Printer Graphics)
- DŪP/1 (Disk Utilities for CP/M and CDOS)
- DŪP/2 (Disk Utilities for Cromemco)
- DŪP/3 (DŪP/2 Expanded)
- SPOOL (Cromemco Format Utility)
- EXPAND (Run Cromemco Software on CP/M)
- BLACKJACK (Tutorial Casino Action)
- DRIVE (Customized Printer Drivers)
- DBMS Conversion to NAD

• Call or Write for Free Catalogue and More Information •

★ We will Customize any of our programs at our Standard Consulting Rates ★

Ah! MICAH . . . .Satisfyin' Software

That turns your system on!

MICro Applications and Hardware

• CONSULTANTS and SOFTWARE DEVELOPERS •

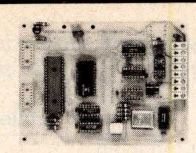
MICAH Box 22212 San Francisco, California 94122 USA phone: 415/664-0778

Circle 125 on inquiry card.

CONTROL THE WORLD THROUGH A EIA RS-232C PORT







ALI has designed a new control system that uses a standard serial port to communicate to over 1000 output points and read over 1000 input points. With this system you can now control relays, lights, motors, D/A, and sense photo eyes, voltage, switches, A/D, keyboards and a lot more. All this control over a single RS-232C link! All it takes is a standard RS-232C port and one or more ALI control modules, per your I/O requirement. Up to 225 modules can be connected to a single EIA RS-232C port.

The modules consist of an I/O CONTROL COMMANDER by itself or in conjunction with one of the specific I/O interface boards. Each I/O CONTROL COMMANDER has 8 TTL inputs and 4 TTL outputs, plus all of the circuitry necessary for proper address decoding and communications timing. Each CONTROL COMMANDER is crystal controlled for highest accuracy and reliability. Baud rate is selectable from 150 to 9600 baud.

Various peripherals can be plugged into the I/O CONTROL COMMANDER to handle specific I/O functions.

	ASSM	KIT
I/O CONTROL COMMANDER • 8 TTL inputs • 4 TTL outputs • 150 to 9600 Baud • Crystal controlled	$149	$129
RELAY INTERFACE • 4 2A, 120V AC relay outputs • 4 5V-120V AC or DC opto-isolated inputs	120	98
UNIVERSAL I/O, KEYBOARD DISPLAY INTERFACE • Up to 16 character display • Up to 32 digits display • Up to 64 individual inputs • Sense full ASCII keyboard • Up to 128 individual outputs	190	152
ALPHA NUMERIC DISPLAY • 16 Alpha numeric displays • Mates with UVKD	179	155
THUMBWHEEL SWITCH UNIT • 8 Digits BCD inputs • 32 Bits TTL input • Mates with UVKD	165	145

As you can see from the above description, you can mix and match modules to meet your specific requirements. All this and more over a single RS-232C link. The above is only a brief summary of the available options.

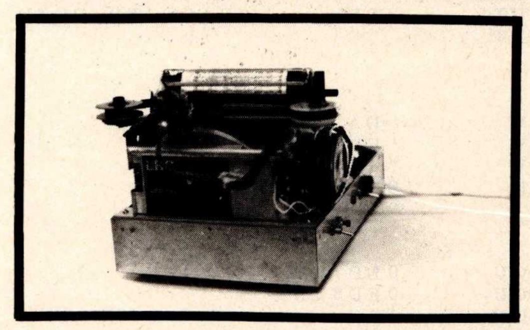
TO ORDER CALL OR WRITE:

AL INDUSTRIES
15 Algonquin Trail, Oakland, N.J. 07436
(201) 337-2030

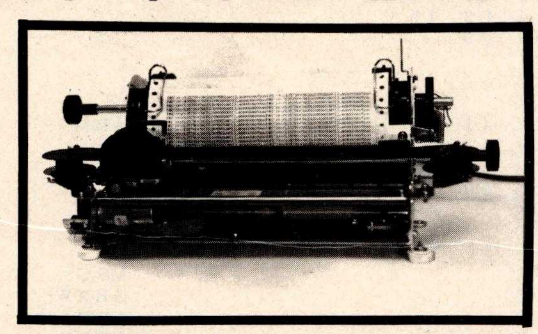
*N.J. Residents add 5% sales tax • Dealers Inquiries Invited

VISA

LOW COST 40 & 80 COLUMN IMPACT PRINTERS



MODEL 101A-40
COST $ 325.00



MODEL 101B-80
COST $ 465.00

- MICROPROCESSOR CONTROLLED IMPACT PRINTER
- 5 X 7 DOT MATRIX
- 96 ASCII UPPER/LOWER CASE CHARACTERS
- PARALLEL & SERIAL INTERFACE
- 110 to 9600 BAUDRATE
- 110 CPS—ONE LINE PRINT RATE
- MANUAL SELF TEST

CoosoL, Inc.

P.O. Box 743 Anaheim, Ca. 92805 (714) 545-2216

Circle 126 on inquiry card.

Listing 1: *8080 subroutine for programming the 2708 EPROM using the circuit described in this article. With minor changes, this routine can be used to program 2716 devices also.*

Address	Object Code	Label	Op Code	Operand	Comments
0000		; PROGRAM FOR PROGRAMMING 2708 PROMS			
0000		; ROBERT GLASER, 11/77			
0000		;			
0000		;			
0000			ORG	0	
0000	21 47 00		LXI	H, ADMS	
0003	CD 79 ED		CALL	MSG	
0006	CD 85 ED		CALL	GHXW	
0009	EB		XCHG		; START ADDR TO DE
000A	06 60		MVI	B, 60H	
000C	0E 00		MVI	C, 0	; LOOP COUNT
000E	21 00 00	LOOPS:	LXI	H, 0	
0011	7D	LOOPC:	MOV	A. L	
0012	D3 14		OUT	ADDL	
0014	78		MOV	A, B	
0015	E6 FC		ANI	0FCH	
0017	B4		ORA	H	
0018	47		MOV	B, A	
0019	D3 15		OUT	ADDH	
001B	E5		PUSH	H	; SAVE PROGRAM ADDR
001C	19		DAD	D	; GET DATA ADDR
001D	7E		MOV	A, M	; GET DATA
001E	E1		POP	H	
001F	D3 16		OUT	DATA	
0021	00		NOP		
0022	00		NOP		
0023	00		NOP		
0024	00		NOP		
0025	00		NOP		
0026	78		MOV	A, B	
0027	F6 80		ORI	80H	
0029	D3 15		OUT	ADDH	; PROGRAM PULSE
002B	AF		XRA	A	
002C	3C	WAIT:	INR	A	
002D	FE 2A		CPI	42	
002F	C2 2C 00		JNZ	WAIT	; WAIT .5 MS
0032	78		MOV	A, B	
0033	E6 7F		ANI	7FH	
0035	47		MOV	B A	
0036	D3 15		OUT	ADDH	; REMOVE PROGRAM PULSE
0038	23		INX	H	
0039	3E 04		MVI	A, 4	
003B	BC		CMP	H	
003C	C2 11 00		JNZ	LOOPC	
003F	0C		INR	C	
0040	C2 0E 00		JNZ	LOOPS	
0043	AF		XRA	A	
0044	D3 15		OUT	ADDH	; BACK TO READ MODE
0046	C9		RET		
0047		;			
0047		;			
0047		;			
0047	41 44	ADMS:	DW	'DA	
0049	44 52		DW	'RD'	
004B	3F 20		DW	' ?'	
004D	00		DB	0	
004E		;			
004E		;			
004E		;			
004E		MSG:	EQU	0ED79H	
004E		GHXW:	EQU	0ED85H	
004E		ADDL:	EQU	14H	
004E		ADDH:	EQU	15H	
004E		DATA:	EQU	16H	

%

data are to be written into the EPROM from that starting point. If the 2708 is to be only partially written, the unused portion of source memory should be filled with the hexadecimal value FF.

Subroutine GHXW gets the 16-bit value which is input in hexadecimal, and places it in register pair HL. The starting address is then moved to DE. Throughout the program this remains the same. Register pair HL contains the actual address applied to the 2708.

LOOPS (loop start) is the beginning of a program loop. At LOOPC (loop continue) the cycle begins. First the address is set up at ports ADDL and ADDH. The data is then fetched and output at the DATA port. Several no-operation instructions are included to guarantee the timing specifications of the 2708.

The program pulse is then applied, and a timing loop of 0.5 ms is entered at WAIT. The program pulse is removed, and the current address is


HOW TO GET THE MOST MILEAGE FROM THE WORLD'S LARGEST COMPUTER CONFERENCE

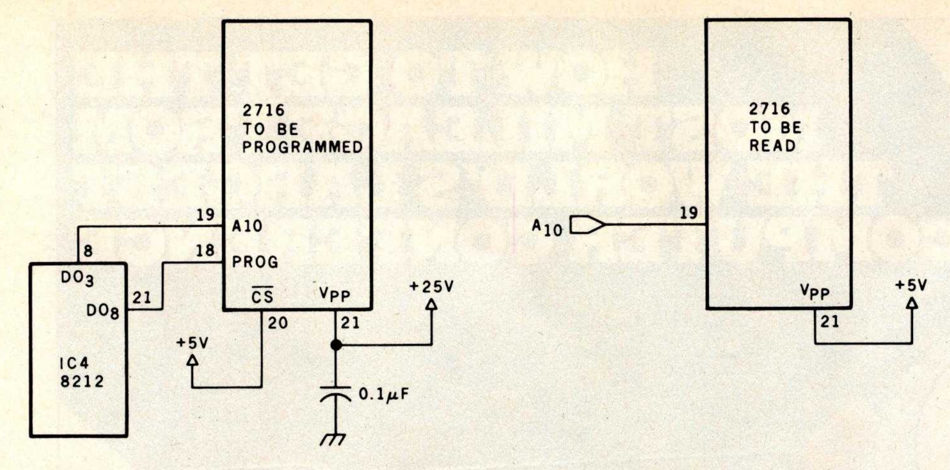


Figure 5: *Modifications to the circuit of figure 3 that enable the programming of the 2716-type EPROM. Modifications to the software are also necessary.*

examined to see if a program loop is finished. If not, the control loops back to LOOPC. If the loop is finished, the loop count is checked to see if all 256 loops have been completed. If not, control goes back to LOOPS.

When the procedure is finished, the 2708 is returned to the read mode, and the routine returns to the calling program. To be on the safe side, timing values are longer than necessary. With the 8080 running at 2 MHz with one wait state, the routine takes 3 minutes and 6 seconds.

Variations

Other EPROMs could be programmed with this setup, as well as 2708s. By changing the value 4 to a 2 in line 42 of the program, 2704s can be programmed with no other modifications. To program 2716s, some other modifications need to be made. The 2716 is a 2 K word by 8 bit EPROM and has some advantages over the 2708. It requires only a +5 V supply for read operation. For programming, the program pulse need only be a TTL level voltage. The high voltage is not pulsed.

Figure 5 shows the necessary circuitry changes to accommodate the 2716. The high voltage applied to pin 21 is +25 V, not the +26 V used for the 2708. Pin 19 is the eleventh address line.

The 2716 needs only a single program loop, but the program pulse should be 50 ms or longer. The program should be modified. Delete lines 11, 45, and 46. The value 4 in line 42 should be changed to an 8, and the delay loop at WAIT should be surrounded by an external loop of 100 to change the 0.5 ms to 50 ms.

To use non8080 systems for programming the EPROM, all that need be done is to reconcile the buses. For 6800-type systems with no discrete output ports, the output ports would have to be addressed as memory.

I have programmed dozens of 2708s with this setup and have had no problems. My application has been with dedicated 8080 controllers. One such controller is used in the local amateur radio repeater to perform various functions. Many program versions were used in this application, since control and autopatch codes are all contained in the programmable read-only memory, which led to many program revisions. The 2708 programmer board was called upon many times. ■

Circle 129 on inquiry card.

Circle 130 on inquiry card.

Apple Audio Processing

Mark A Cross
Physics Department
Grambling State University
Grambling LA 71245

Tired of poking single tones into your speaker? The Apple is capable of talking or playing several notes simultaneously. It can be done in one evening from very simple homebrew interfaces.

There are at least three ways to get speech out of an Apple. The APPLE-TALKER program by Bob Bishop accepts voice from the cassette input, processes and stores the data, and then pokes it to the internal speaker. A second way is to use a voice synthesizer built on a plug-in card, such as the one made by Mountain Hardware. The third method is described in this article.

The references give the theory behind the methods of analog-to-digital (A/D), input, data storage, digital-to-analog (D/A), and output. They emphasize high sampling rates. Yes, it would be best to sample the input at 100 kHz and store it with 12-bit accuracy to create a high-fidelity computer. This is needed for music, but we are accustomed to sloppy speech. We can sample speech at 2000 Hz, store the data, and send it out to a 4-bit digital-to-analog converter. This reproduces speech which sounds very similar to that reproduced by a tape recorder!

Audio Input

The Apple has four game paddle inputs. These generate a count from 0 to 255 in response to a resistance from 0 to about 130 k ohms. The internal circuit shown in figure 1 has a 553 timer which discharges the 0.022 μF capacitor in response to a LDA $C070 instruction. Then a software counter runs while the capacitor is charged by the +5 V supply at a rate set by the paddle 0 resistance. When the capacitor reaches a trigger voltage, the 553 changes state and the counter stops. The program sequence used to create the counter is as follows:

label	mnemonic	operand	comment
	LDA	$C070	Discharge capacitor.
	LDY	#00	Initialize count.
	NOP		
	NOP		
READ	LDA	$C064	Check status of 553 timer.
	BPL	DONE	
	INY		
	BNE	READ	
	DEY		
DONE			

The execution time of this subroutine is a function of register Y. It takes the time $t = 16 + (10 \times Y)$ μs to execute. Suppose that $Y = 7$. Then the rate of cycling through the counter is $f = 1/t$ or approximately 11,600 Hz, minus overhead for storing the data. Speech at 100 to 1000 Hz is well within this sampling rate. Low fidelity music is also possible.

Figure 2 shows how to build a very simple amplifier that will convert an audio input into a variable resistance. The microphone should be a moving coil type. About 10 mV will be generated by the inexpensive microphones that used to be included with cassette recorders, or you can simply talk into a loudspeaker. The input capacitor should be 0.1 μF or more, nonpolarized. If the input capacitor is too small then it will block most of the input. The transistor is any NPN type out of a spare parts box (such as a 2N2222).

I used a 2 M ohm potentiometer for the base resistor. It will be adjusted later to allow for variations between transistors. You might want to include a 100 k ohm fixed resistance in series with the variable 2 M ohm resistance to prevent adjusting the base resistance to zero and destroying the transistor.

The base resistance allows a small current to flow that is amplified by the transistor to make a larger collector current. Both currents flow through the emitter to charge the internal 0.022 μF capacitor. Thus, the steady state of this imitation game paddle can be set by adjusting the base resistance. When you apply a small AC voltage from the microphone, the base current changes. This in turn changes the paddle's effective resistance.

The input circuit can be built on a 16-pin socket as suggested on page 118 of the *Apple II Reference Manual* (the red book). It is difficult to adjust the resistance R and capacitance if you do this. You can also connect two wires from pins 1 and 6 of the game paddle connector and build the amplifier on a breadboard.

Check out the amplifier in BASIC while running line 10 of listing 1 below. Adjust R to get a steady 7 or 8 paddle reading, for the fastest sampling. (Half of fifteen, for the 4-bit output to be used, equals the DC level before the you start talking.) A range of at least 4 units (8 is most desirable) change in PDL (0) caused by your speech is needed. Yell into the mike and hit control-C. You will get more gain by adjusting the base resistance to be larger, or by increasing the input capacitor value.

Text continued on page 216

Listing 1: *Integer BASIC routines for testing the audio-input interface and manipulating the stored data. The routine starting on line 1000 produces a record of different numbers in the raw data. Note the minimum and maximum for later use. Lines 2000 thru 2080 scale the waveforms into the range 0 to 15. First, the minimum is subtracted from every data point to shift it down to 0. Then the wave is either clipped or compressed to bring the maximum down to 15. Lines 3000 thru 3050 send the audio data to the output trying all possible delays. The routine starting at line 4000 compresses the data by discarding every other data point. Lines 5000 thru 5040 show how to call the input subroutine.*

```
>LIST
  10 PRINT PDL (0): GOTO 10: REM  TEST THE INPUT AMPLIFIER
 900 REM
1000 DIM N(80): REM  STUDY THE AUDIO DATA
1010 FOR I=0 TO 80:N(I)=0: NEXT I
1020 FOR I=2816 TO 12287: REM  AUDIO DATA AREA
1030 X= PEEK (I):N(X)=N(X)+1: NEXT I
1040 PRINT "I      N(I)       N(20+I)   N(40+I) N(60+I)"
1050 FOR I=0 TO 19
1060 PRINT I,N(I),N(20+I),N(40+I),N(60+I)
1070 NEXT I: END
1900 REM
1990 REM  INPUT THE SPEECH DATA
2000 FOR I=0 TO 80:N(I)=0: NEXT I
2010 INPUT "MINIMUM DATA ",MIN
2020 INPUT "MAX DATA ",MAX
2030 FOR I=2816 TO 12287
2040 X= PEEK (I)-MIN
2050 X=X*15/(MAX-MIN): REM  COMPRESSING
2060 IF X>15 THEN X=15: REM  CLIPPING
2070 N(X)=N(X)+1: POKE I,X
2080 NEXT I: GOTO 1040
3000 INPUT "TURN ON AMPLIFIER AND PRESS RETURN.",A$
3010 FOR DELAY=0 TO 255
3020 PRINT DELAY
3030 POKE 2561,0: POKE 2562,12
3040 POKE 2612,DELAY: CALL 2560
3050 NEXT DELAY: END
3900 REM
3990 REM  COMPRESS THE DATA BY DISCARDING HALF OF IT
4000 X=(12287-2816)/2: REM  HALF OF DATA AREA
4010 FOR I=1 TO X
4020 POKE 2816+I, PEEK (2816+2*I)
4030 NEXT I: END
4900 REM
5000 REM  CALL INPUT SUBROUTINE
5010 INPUT "HIT RETURN WHEN READY TO TALK.",A$
5020 POKE 2325,0: POKE 2326,11
5030 POKE 2346,0: POKE 2339,48
5040 POKE 2321,13: CALL 2304: END
```

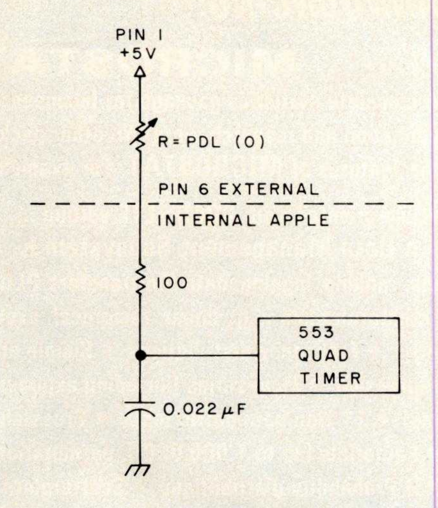


Figure 1: *A representation of the paddle-input system used by the Apple II computer.*

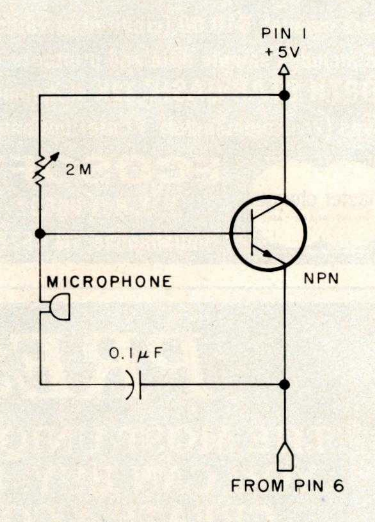


Figure 2: *A microphone and simple amplifier can be added to the Apple paddle connector and used to input audio information. The program in listing 2 is used with this circuit.*

Text continued from page 212:

BASIC cannot sample the game paddle fast enough to follow sounds. The program in listing 2 will do that. Hexadecimal locations 0900 thru 0912 loop indefinitely waiting for the user's initial voice input. When the paddle count reaches (THRESH + 1) (THRESH is threshold to start recording data), the rest of the program begins sensing and storing data. The user can insert a delay loop at hexadecimal 093E to wait between data points and get more (but lower quality) speech into memory.

A standard 16 K byte memory holds one or two words of good quality speech. You can adjust the base resistance in the amplifier to make a large steady PDL (0) value of 50 or more and thus sample the input more slowly. "Row, row, row your boat gently down the stream" will fit in, but the rest of the song might be too noisy if compressed into 16 K bytes.

Listing 2: *6502 assembly-language program to drive the audio-input interface. This reads the voice data from a microphone connected to a game paddle. The data is stored in locations START thru END. When ENDHI equals 48 (decimal), then LOMEM:12289 will put all BASIC work above the audio data area. There are several adjustable parameters: THRESH: threshold to start recording data. Should be 2 or 3 units above the steady state, no-speech PDL(0). STARTLO, STARTHI: start of the data storage area. ENDLO, ENDHI: = LOMEM − 1: end of audio area.*

```
0900-  AD 70 C0  LDA   $C070
0903-  A0 00     LDY   #$00
0905-  EA        NOP
0906-  EA        NOP
0907-  AD 64 C0  LDA   $C064
090A-  10 04     BPL   $0910
090C-  C8        INY
090D-  D0 F8     BNE   $0907
090F-  88        DEY
0910-  C0 10     CPY   #$10
0912-  30 EC     BMI   $0900
0914-  8C 00 0B  STY   $0B00
0917-  EE 15 09  INC   $0915
091A-  D0 03     BNE   $091F
091C-  EE 16 09  INC   $0916
091F-  AD 16 09  LDA   $0916
0922-  C9 30     CMP   #$30
0924-  30 08     BMI   $092E
0926-  AD 15 09  LDA   $0915
0929-  C9 00     CMP   #$00
092B-  D0 01     BNE   $092E
092D-  60        RTS
092E-  AD 70 C0  LDA   $C070
0931-  A0 00     LDY   #$00
0933-  EA        NOP
0934-  EA        NOP
0935-  AD 64 C0  LDA   $C064
0938-  10 04     BPL   $093E
093A-  C8        INY
093B-  D0 F8     BNE   $0935
093D-  88        DEY
093E-  4C 14 09  JMP   $0914
0941-  FF        ???
0942-  00        BRK
0943-  00        BRK
0944-  FF        ???
0945-  FF        ???
0946-  00        BRK
0947-  00        BRK
0948-  FF        ???
```

Processing

After the waveform data is stored in memory it can be easily improved, condensed, or distorted. Try the short programs in Tom O'Haver's article (see references). Keep in mind that the 4-bit output requires all data to be in the range 0 to 15.

The routines in listing 1 can be used to scale, compress, and output the data.

Output

The game connector has four annunciator outputs. These are compatible with the 4-bit digital-to-analog converter shown in figure 3. Build it on the socket that the input amplifier is connected to.

The idea of using a resistor network for digital-to-analog conversion is discussed by Hal Chamberlin (see references). The minimum resistance here is 5 k ohms so that the maximum current drawn from the annunciator outputs will be 1 mA. High-precision resistors are not necessary. The digital-to-analog conversion truncates the fifth bit, which introduces a 3% error. Five-percent tolerance resistors will do.

The capacitor in figure 3 filters out high-frequency noise. The noise comes from truncation to 4 bits, from delays between taking samples of the audio input, and from not changing all 4 bits of the digital output simultaneously. A larger capacitor on the output will filter out more noise, but it will also attenuate the signal, thus, you will have to turn up the amplifier's gain. A better low-pass filter would help.

The output software is shown in listing 3. It fetches a byte of waveform data, sends it to the digital-to-analog converter, increments and tests the memory pointer, waits for a delay, and then fetches another byte of data.

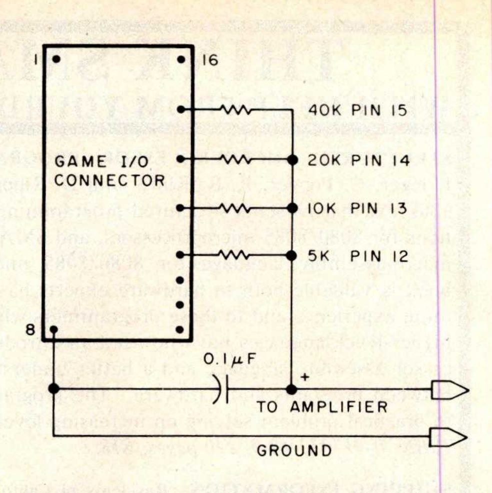


Figure 3: *This simple 4-bit digital-to-analog (D/A) converter, along with listing 3, is used to output information created by the circuit shown in figure 2 and the program shown in listing 2.*

Listing 3: *6502 assembly-language program that sends audio data to the 4-bit digital-to-analog (D/A) converter.*

```
*A00LL

0A00-  AD 00 0B  LDA   $0B00
0A03-  6A        ROR
0A04-  B0 05     BCS   $0A0B
0A06-  8D 58 C0  STA   $C058
0A09-  90 04     BCC   $0A0F
0A0B-  8D 59 C0  STA   $C059
0A0E-  EA        NOP
0A0F-  6A        ROR
0A10-  B0 05     BCS   $0A17
0A12-  8D 5A C0  STA   $C05A
0A15-  90 04     BCC   $0A1B
0A17-  8D 5B C0  STA   $C05B
0A1A-  EA        NOP
0A1B-  6A        ROR
0A1C-  B0 F5     BCS   $0A13
0A1E-  8D 5C C0  STA   $C05C
0A21-  90 04     BCC   $0A27
0A23-  8D 5D C0  STA   $C05D
0A26-  EA        NOP
0A27-  6A        ROR
0A28-  B0 05     BCS   $0A2F
0A2A-  8D 5E C0  STA   $C05E
0A2D-  90 04     BCC   $0A33
0A2F-  8D 5F C0  STA   $C05F
0A32-  EA        NOP
0A33-  A2 1E     LDX   #$1E
0A35-  CA        DEX
0A36-  D0 FD     BNE   $0A35
0A38-  EE 01 0A  INC   $0A01
0A3B-  D0 03     BNE   $0A40
0A3D-  EE 02 0A  INC   $0A02
0A40-  AD 02 0A  LDA   $0A02
0A43-  C9 30     CMP   #$30
0A45-  D0 05     BNE   $0A4C
0A47-  AD 01 0A  LDA   $0A01
0A4A-  C9 00     CMP   #$00
0A4C-  D0 B2     BNE   $0A00
0A4E-  60        RTS
0A4F-  00        BRK
0A50-  FF        ???
```

Circle 275 on inquiry card.



The world's most popular microcomputer, with 16K of memory and Level 11 basic for only $750, complete with full 90 day Radio Shack warranty. We accept check, money order or phone orders with Visa or Master Charge. (Shipping costs added to charge orders). Disk drives, printers, peripherals, software and games . . . you name it, we've got it (Both Radio Shack & other brands). Write or call for our complete price list.



Shown is Level I. Level II includes Alphanumeric keypad.

C&S ELECTRONICS MART Ltd.

AUTHORIZED DEALERSHIP **Radio Shack**

32 E. Main Street ● Milan Michigan 48160 ● (313) 439-1400

Business Software in Micropolis Basic

DATASMITH announces the availability of two new turnkey business systems designed especially for MICROPOLIS-Based computers, including the VECTOR MZ. Both systems are completely menu driven and highly interactive, so they can be used effectively by your present office staff.

- **GENERAL LEDGER.** Everything you need to keep the books. Features easy-to-use data entry and error correction, trial balance, posting, and a variety of comprehensive reports. Automatic error detection keeps the books in balance. Writes checks and makes journal entries in one operation.
- **PAYROLL.** A very flexible system that adapts to a wide variety of needs. Features federal, state, and local tax calculations, EIC credit, and special pay and deduction amounts. Prints all necessary reports, paychecks, and W-2 forms.

Put your computer to work with these comprehensive systems now. Call or write for complete details. Custom services also available.

DATASMITH

15501 West 109th St., Lenexa, KS 66219, (913) 888-8486

Circle 139 on inquiry card.

SAVE ON ADD-ON PRODUCTS FOR TRS-80

The largest family of disk drives from the largest supplier, drives come complete with power supply and cabinet.



TF-Pertec FD200, 40 track, use both sides	$382
TF-3 Shugart SA400, 35 track, same as tandy	$389
TF-5 MPI B51, 40 track	$379
TF-70 Micropolis, 77 track with 195K of storage	$639
TDH-1 Dual sided drive, 35 track	$499

MAX-DISC TWO

Maxi Disk 1: 10 Megabyte Hard Disk with 5 fixed, 5 removable with controller	$6299
Maxi Disk 2: 10 Megabyte (fixed) Winchester Technology	$5349
77 tracks of Storage includes new DOS+	$695

PRINTERS

DP800 Anadex, 80 column, 112cps	$950
LP779 Centronics 779	$1099
LP730 Centronics 730	$950
LP700 Centronics 700-1	$1495
LP701 Centronics 701-1	$1759
LP702 Centronics 702-2	$1995
SPW-1 Spinwriter-NEC	$2495

NEW! LINE PRINTER BASE 2

Base 2 Printer 80, 132 col., graphics 60 LPM with tractors **$599**

*** DRIVES FOR ANY MICROCOMPUTER ***

Does not include power supply & cabinet.

MOD II DISK DRIVES NOW AVAILABLE

Perfec FD200	$282
Perfec FD250 (dual head)	$399
Shugart SA400 (unused)	$286
Shugart SA800	$479
MPI B51	$279
MPI B52	$349

SOFTWARE

New DOS+ with over 200 modifications and corrections to TRS-DOS	$99
New DOS+ 40 track	$110
AJA Word Processor	$75
AJA Business Program	$250
Racet Infinite Basic	$49.95
Disk Drive Alignment Program	$109
Radix Data Base Program	$99.95
Electric Pencil	$150

ALL PRICES CASH DISCOUNTED. FREIGHT FOB/FACTORY



3304 W. MacArthur
Santa Ana, CA 92704
(714) 979-9923

Circle 140 on inquiry card.



7310 E. Princeton Ave.
Denver, CO 80222
(303) 758-7275

Circle 141 on inquiry card.

Conclusion

The speech quality produced by this method is relatively good. Most music doesn't turn out very well when the high frequencies are filtered out. I tried "The Star Spangled Banner" from the article by Hal Chamberlin. The music was tolerable but my simple capacitor filter let through too much high-frequency noise (reference 3).

Memory Locations Decimal	Hexadecimal	Usage
0-2047	000-07FF	System usage
2048-2303	0800-08FF	Blank
2304-2559	0900-09FF	Input subroutine
2560-2815	0A00-0AFF	Output subroutine
2816-LOMEM	0B00-LOMEM	Audio data storage
LOMEM-HIMEM		BASIC

Table 1: *Memory map for speech input and output routines.*

2a Address Hexadecimal	Decimal	Variable Name	Suggested Value (Decimal)
0911	2321	THRESH	13
0915	2325	STARTLO	0
0916	2326	STARTHI	11
0923	2339	ENDHI	48 for 16 K bytes
092A	2346	ENDLO	0
2b Address Hexadecimal	**Decimal**	**Variable Name**	**Suggested Value (Decimal)**
0A01	2561	STARTLO	0
0A02	2562	STARTHI	11
0A34	2612	DELAY	47

Table 2: *Tables of variable locations and values. Table 2a lists the location and suggested value of several constants that must be specified within listing 2; table 2b does the same for listing 3. In both cases, the constants are stored within the body of the listing.*

An 8-bit digital-to-analog converter can be built. I did so, but found that it resulted in no significant audible difference for speech. Such an option might be advantageous only if you are interested in high-fidelity music reproduction.

The main problem is the available memory which limits the amount of audio information that can be stored. Slower sampling can store more data, but this introduces too much noise when the sampling rate falls below 1000 to 2000 Hz. You can double up and store 2 units of data in 1 byte of memory. I have been able to get phonemes (eg: single letter sounds) compressed to 256 bytes of memory on the average.

The input routine in listing 2 could be improved. The routine now spends less time sampling low-amplitude inputs and more time sampling high-amplitude inputs. There should be another counter that waits during a variable interval depending on the input amplitude, which is indicated by register Y.

You can change the amplitude of the waveforms. Either divide all the data by 2 in BASIC, or insert an extra rotate right (ROR) instruction in the output routine just before the data gets to the digital-to-analog conversion section. The speech is still intelligible when it is cut down to 2 or 3 bits of data! A better output routine would have a parameter to choose full, ¾, ½, or ¼ amplitude. (Of course this won't work when the audio amplifier is a tape recorder with automatic level control.)

A minimum set of compressed phonemes needs about 10 K bytes (for 40 phonemes,each occupying 256 bytes) of memory. Room is left over for BASIC programs or extra phonemes. With variable pitch and amplitude, you can accent syllables in words. Variable pitch plus extra long vowels could effectively make a singing Apple! ■

References

1. Chamberlin, Hal, "A Sampling of Techniques for the Computer Performance of Music," September 1977 BYTE, page 62.
2. Ciarcia, Steve, "Talk to Me," June 1978 BYTE, page 142.
3. Cross, Mark, "Apple Organ," a program based on reference 1.
4. O'Haver, Tom, "Audio Processing with a Microprocessor," June 1978 BYTE, page 166.

BYTE's Bugs

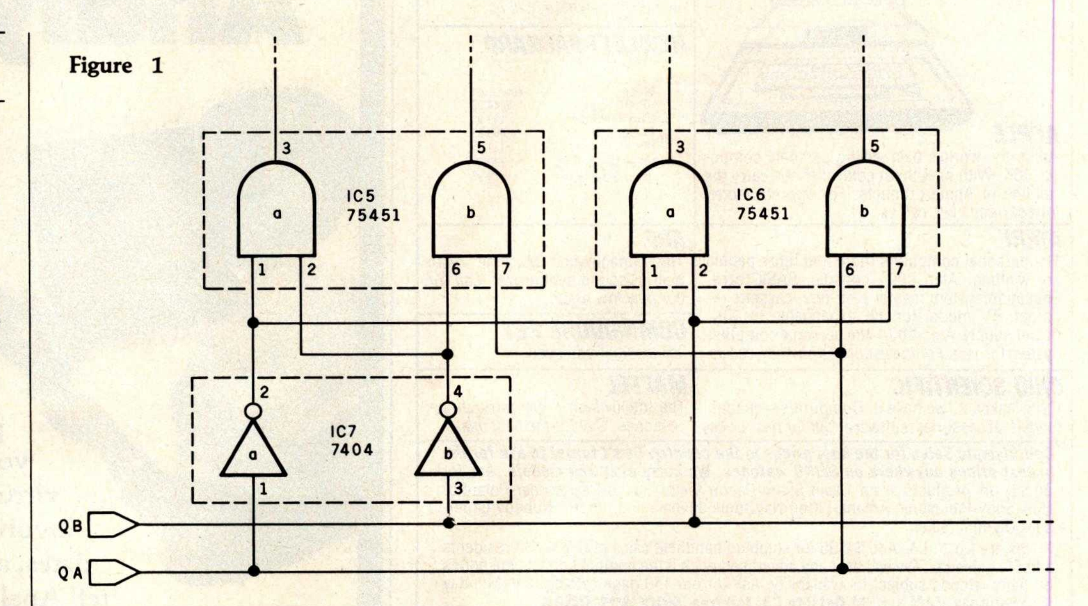
Schematic Decodes Improperly

An error marred a schematic diagram in William J Dally's article "Faster Audio Processing with a Microprocessor," on page 54 of the December 1979 BYTE. In figure 12 on page 75, two connections to a 7404 hex inverter are shown incorrectly. The correct connections are shown here as figure 1. A circuit built according to the published diagram would fail to decode the binary states 01 and 10 properly.

IC5b is supposed to decode the input 01. However, its inputs incorrectly come from the signals Q_A and $\overline{Q_A}$ in the published figure. The inputs to IC5b should come from the signals Q_A and Q_B. A similar situation exists for IC6a. Input for IC6a should come from Q_B and Q_A.

Thanks to Bob Werner of Solon, Iowa, for pointing out this problem. ■

Figure 1



Clubs and Newsletters

Another TRS-80 Users Group

The NASA/Bay Area TRS-80 Users Group meets the first Tuesday of each month in the Lockheed Bldg, L XI, Rm 2012, Space Park Dr, Nassau Bay TX. The dues are $5 per year. Contact Roy Cone, President, (713) 474-3847.

Computer Club in Finland

The "Mikrotietokoneyhdistys ry" translates into Microcomputer Hobbyists. This club has been in operation since June, 1977. Meetings are held bimonthly and are announced in the newsletter. The newsletter, *Microman*, is published six times a year. The club is interested in hardware and software related topics, and has a strong interest in advanced programming languages such as Pascal, ADA, APL and others. Their hardware interests include S-100 and IEEE-488 bus structures. The yearly dues for membership and the newsletter are 80 FIM or $20 US currency. Contact Mr Teuvo Aaltio, POB 250, SF-00121 Helsinki 12, FINLAND, (+358 0) 626 525.

The Financial Systems Report

The Financial Systems Report is a monthly newsletter that focuses on computer programs, products, and services relevant to the needs of the financial and tax consultant. Tax planning programs, financial modeling and forecasting systems, financial data bases, portable computers and telecommunication terminals, personal financial planning systems, microcomputers, and more will be covered in each issue. It is available for $60 per year from Syntax Corp, 4500 W 72nd Ter, POB 8137, Prairie Village KS 66208.

SYM-PHYSIS Newsletter

SYM-PHYSIS is a bimonthly newsletter published by the SYM Users Group, POB 315, Chico CA 95927. They welcome articles dealing with all aspects of the SYM-1 and its close relatives. The subscription rate for a six-issue volume is $9 in the US and $12.50 overseas. For more information, contact H R "Lux" Luxenberg at the above address.

PEEK (65)

PEEK(65), the unofficial Ohio Scientific users' journal, features a software exchange, PEEKs and POKEs, user equipment reviews, and bugs and fixes. Articles are welcome. Membership is $8 per year. Send inquiries to *PEEK(65)*, 62 Southgate Ave, Annapolis MD 21401.

Computers Anonymous

This club meets the first Sunday of each month. For complete information, contact Computers Anonymous, POB 263, Dalton MA 01226.

Albany Computer Society

The goal of this group is to serve as a forum for ideas and products of interest to computer hobbyists. The members are interested in anything pertaining to Sorcerers, Apples, Challengers, and TRS-80s. Meetings are held the second Saturday of each month at Albany Junior College and are open to the public. Contact Albany Computer Society, c/o Dr Donald Cook, 2400 Gillionville Rd, Albany GA 31707.

Join a Software Computer Club

Specify which computer you use and Ron Goodman will put you in contact with the right people. Apple, PET, Compucolor, Ohio Scientific, TRS-80, and other microcomputer users are welcome to join. For more information, contact Ron Goodman, 12702 Emelita St, N Hollywood CA 91607.

APL Newsletter

Personal APL News, written by the Rev Mokurai Cherlin and Shasta Abbey, covers hobby, educational, professional, and small-business uses of APL. The newsletter describes the use of APL as a programming language and as a mathematical notation and digital hardware design language. One feature is the resource directory, giving details of available APL hardware, software, services, and books. The cost is $1 in the US and Canada and $2 elsewhere. Send subscriptions and inquiries to *Personal APL News*, POB 1131, Mt Shasta CA 96067.

The Computer Club

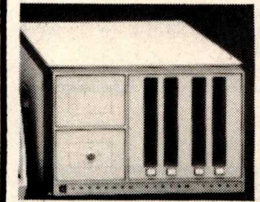
The Computer Club offers an invitation to all computer users and owners in southern New England who wish to share their knowledge. The club meets once a month to discuss problems, ideas, and discoveries. For further details, contact The Computer Club, 6 Maureen Dr, Simsbury CT 06070.

Circle 151 on inquiry card.

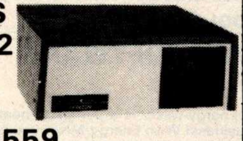
WE CARRY —

- CROMEMCO
- NORTH STAR
- VECTOR GRAPHICS
- THINKER TOYS
- NEC
- CENTRONICS
- INTERTUBE — $750.00
- SERENDIPITY
- SOROC — $775.00
- TEXAS INSTRUMENTS

Professional A/R, A/P, Ledger, Payroll, Medical Billing software with customization available. Send for our catalog — Send for quote.
Call for quote.



SARA-TECH COMPUTERS
P.O. Box 692
Venice, FL
33595
(813) 485-3559



---

for TRS-80 II, Compucolor II, & PET

EVERYTHING YOU NEED TO BRING YOUR BASIC PROGRAMS TO LIFE WITH SOUND!

SOUNDWARE is a complete package:

YOU GET A SPEAKER/AMPLIFIER UNIT complete with connectors. No wiring or soldering. Just plug in!

YOU GET A DEMO PROGRAM with a variety of sample sound effects—sirens, laser sounds, tunes!

YOU GET A COMPOSER PROGRAM to help you create your own original sound effects. Fun for all ages!

YOU GET AN INSTRUCTION BOOKLET that tell you how to insert sound into your programs. 1 year warranty.

SOUNDWARE™

	Complete Package	or	Programs & Booklet
ALL PETS & TRS-80 II	$29.95		$14.95
Compucolor II	$39.95		$19.95

SEND FOR FREE CATALOG OF GAMES FOR PET & COMPUCOLOR!!

SEE YOUR DEALER TODAY! Or order direct from CAP by phone or mail. VISA & MasterCharge orders include expiration date. Add $1 postage & handling per order. $3 for air or COD. Arizona residents add tax.

CAP Electronics 8462 Hillwood Ln., Suite 3. Tucson, AZ 85715 (602) 296-4978

North Star Horizon

Heath H89

Cromemco C3

We got'em all talking.

TRS-80 Model I

TRS-80 Model II

Your Computer

"BSTAM"

Byrom Software Telecommunications Access Method

The missing link between any CP/M or TRSDOS computers!

A commercially oriented telecommunications facility for transmitting and receiving CP/M* and TRSDOS** files, BSTAM has BIG computer features for your micro:

- links computers directly at 9600 baud with UARTS, or via phone lines using modems
- full speed data transfer without hex conversion overhead
- full wildcard expansions to send * .COM, etc.
- reliable error detection and automatic retry with console messages for status and errors

It's Terrific!
We use it ourselves!

$150 PER COMPUTER $5 MANUAL ALONE

Prices reflect distribution on 8" single density diskettes. If a format is requested which requires additional diskettes, a surcharge of $8. per additional diskette will be added.

*CP/M is a trademark of Digital Research
**TRSDOS is a trademark of Tandy Corporation

Lifeboat Associates THE SOFTWARE SUPER-MARKET

Lifeboat Associates
2248 Broadway New York, N.Y. 10024 (212) 580-0082 Telex: 220501

1802 Software Newsletter

The 1802 Software Newsletter contains programs written in Tiny BASIC, BASIC, PILOT, CHIP-8, and other languages, and in assembly and hexadecimal object code. The newsletter averages fifteen pages per issue. Construction articles are included. The newsletter is for ELF, ELF II, Super ELF, VIP, VIP II, or homebrew 1802 systems. It is published monthly and costs $10 per year. Contact 1802, 19 French Cr, Regina, Saskatchewan S4R 6N3 CANADA.

The Computer Consultant

The Computer Consultant is published six times a year by Battery Lane Publications, POB 30214, Bethesda MD. The newsletter consists of short entries from computer consulting companies, including software design firms, training organizations, security consulting outfits, systems programmers, and other computer-related consulting companies. The subscription rate of $15 per year includes one free listing per issue.

TRS-80 Users Group in Maine

The Southern Maine TRS-80 Computer Club meets the first Tuesday of each month at 6:30 PM at the Maine Medical Center, Portland, Maine, in Classroom 2. Contact Douglas Stewart, 15 Mountain View Rd, Cape Elizabeth ME 04107.

An Apple Users Group in California

The Los Angeles Apple Users Group meets the first Friday of every month at 7:30 PM at the Allstate Savings Community Room, 8800 S Sepulveda Blvd, Los Angeles, California. Contact Philip A Wasson, 9513 Hindry Pl, Los Angeles CA 90045. ■

Circle 153 on inquiry card.

Model EP-2A-79

EPROM Programmer



Software available for F-8, 6800, 8085, 8080, Z-80, 6502, 1802, 2650,6809, 8086 based systems.

EPROM type is selected by a personality module which plugs into the front of the programmer. Power requirements are 115 VAC 50/60 Hz. at 15 watts. It is supplied with a 36-inch ribbon cable for connecting to microcomputer. Requires 1½ I/O ports. Priced at $155 with one set of software. (Additional software on disk and cassette for various systems.) Personality modules are shown below.

Part No.	Programs	Price
PM-0	TMS 2708	$15.00
PM-1	2704, 2708	15.00
PM-2	2732	30.00
PM-3	TMS 2716	15.00
PM-4	TMS 2532	30.00
PM-5	TMS 2516, 2716, 2758	15.00
PM-8	MCM68764	33.00

Optimal Technology, Inc.

Blue Wood 127, Earlysville, Virginia 22936

Phone (804) 973-5482

DATADISK SYSTEMS

PROFESSIONAL SOFTWARE FOR NORTH STAR SYSTEMS

DIGITAL RESEARCH

CP/M*2.0 — Digital Research's latest disk operating system for 8080/8085/Z80 based microcomputers, now specially tailored for the North Star disk systems. Includes ED text editor, DDT debugger, ASM assembler, additional utility programs and complete documentation. CP/M 2.0 is upward compatible with earlier releases and makes a wealth of professional software available to your system. .... **†$150/$25**

TEX - A powerful text formatter. Produces finished copy with automatic page numbering, left and right margin justification, indentation, page headers, line centering and other quality features. Output may be vectored to printer, disk or console......... **$70/$15**

MAC — 8080 Macro assembler. Allows use of library programs, greatly increasing programming efficiency. Uses Intel macro conventions. Assembly toggles allow listing, hex and symbol table outputs to be directed to disk, printer, console or combination. A tremendous development aid. .... **$85/$15**

SID — Symbolic Instruction Debugger for the 8080. Allows multiple break points with user set pass counter. Displays user labels during debugging when used with MAC. Greatly reduces hard-copy listing requirements. Includes back-trace and histogram utilities. A must for serious software development. .... **$85/$15**

ZSID — Same as SID except incorporates complete Z80 instruction set and uses Z-80 mnemonics. .... **$95/$15**

DESPOOL — Allows simultaneous printing of disk files and user access to other programs. No need to stop production while lengthy printouts are in progress. .... **$45/$5**

SOFTWARE SYSTEMS

CBASIC-2 — A commercially oriented, compiler-interpreter extended disk BASIC. Self documenting, using full length variable labels without penalizing speed. Compiler permits distribution of software without releasing source code. .... **$105/$15**

California residents add 6% sales tax.
Specify single, double or quad capacity.
Additional formats available soon.
Structured Systems Group programs require CP/M and CBASIC-2.

*CP/M is a registered trademark of Digital Research.
†Software and documentation/documentation only.




BUSINESS SOFTWARE FROM STRUCTURED SYSTEMS GROUP

GENERAL LEDGER — A comprehensive applications package for business accounting or CPA multi-client write up. Produces financial reports to user defined specifications. Interactive posting, balance sheet, income statement, general and cash disbursement journals, sort, multiple profit centers, accounts distribution and much more. Outstanding package. .... **$895/$25**

ACCOUNTS RECEIVABLE — A complete open item or balance forward system. Operates alone, or interfaces with General Ledger. Produces customer statements, aged trial balance, on-line inquiry, sales reports, reminder notices and more. ...... **$695/$25**

ACCOUNTS PAYABLE — A powerful cash management system. Aged account statements, writes checks, cash requirements projection, General Ledger update and more included. Stand alone operation or interfaces with General Ledger and QSORT.......................... **$695/$25**

NAD — Name and Address System - Stores mailing lists on disk. Prints mailing labels or lists additional references information. Selective data extraction. .... **$75/$10**

QSORT — A generalized, full disk sort/merge package. Fast and flexible. Multiple key sorting. .... **$95/$15**

LETTERIGHT — Word processing for the business office. Produces professional correspondence, letters, envelopes, and more. High speed production with minimal training. Multiple personalized letters produced when used with list formed by NAD. .... **$175/$20**

ANALYST — Generalized data base management program. Stores and retrieves disk data producing user formatted reports. Interactive input. Easy to use. Tremendous versatility. .... **$225/$20**

INVENTORY — Complete inventory control program limited in capacity only by your disk size. On-line inquiry, average valuation, reorder and activity reports with report range option. Menu driven and fully auditable, the system uses full screen formatting and permits user defined record numbers. .... **$795/$25**

NOW—AN AFFORDABLE HARD DISK

Ask about our 13.2 megabyte Winchester technology hard disk business system. Uses all above listed software. Price varies with software configuration.

Datadisk Systems, P.O. Box 195, Poway, CA 92064, (714) 578-3831

Circle 154 on inquiry card.

DYNACOMP

Quality software for: Apple II Plus
TRS-80 (Level II)
North Star

All software is supplied with complete documentation which includes clear explanations and examples. Each program will run with standard terminals (32 characters or wider) and within 16K program memory space. Except where noted, all software is available on North Star diskette (North Star BASIC), TRS-80 cassette (Level II) and Apple cassette (*Applesoft* BASIC). These programs are also available on *PAPER TAPE* (Microsoft *BASIC*).

FLIGHT SIMULATOR

Price: $17.95 postpaid

(as described in SIMULATION, Volume II)

A realistic and extensive three-dimensional simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers.

SIMULATION, Volume II (BYTE Publications): $6.00

VALDEZ

Price: $14.95 postpaid

A simulation of supertanker navigation in the Prince William Sound and Valdez Narrows. The program uses an extensive 256X256 element radar map and employs physical models of ship response and tidal patterns. Chart your own course through ship and iceberg traffic. Any standard terminal may be used for display.

BRIDGE 2.0

Price: $17.95 postpaid

An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice.

HEARTS 1.5

Price: $14.95 postpaid

An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies.

DATA SMOOTHER

Price: $14.95 postpaid

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER

Price: $14.95 postpaid

Use this program to examine the frequency spectra of limited duration signals sampled at equal intervals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

MAIL LIST I

Price: $18.95 postpaid (available for North Star only)

A many-featured mailing list program which sorts through your customer list by user-defined product code, customer name or Zip Code. Entries to the list can be conveniently added or deleted and the printout format allows the use of standard size address labels. Each diskette can hold approximately 900 entries.

MAIL LIST SERVICE

DYNACOMP can provide you with a customized mail list service. Your customer/patient records are placed in a master computer file and you are provided with addressed, self-adhesive labels for your mailings. These labels may be sorted by name, Zip Code, date, or other identifiers. Write for further details and a price schedule.

TEXT EDITOR I (Letter Writer)

Price: $14.95 postpaid

An easy to use, line-oriented text editor which provides variable line widths and simple paragraph indexing. This text editor is ideally suited for composing letters and is quite capable of handling much larger jobs.

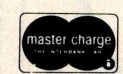
GAMES PACK I

Price: $10.95 postpaid

Seven entertaining games for less than a dollar a kilobyte! Play CATAPULT, CRAPS, SWITCH, HORSERACE, SLOT MACHINE, BLACKJACK and LUNAR LANDER. This is an excellent way to introduce your children to computers.

All orders are processed within 48 hours. Please enclose payment with order. If paying by MASTER CHARGE or VISA, include all numbers on card. Foreign orders add 10% for shipping and handling.

Write for detailed descriptions of these and other programs available from DYNACOMP.



DYNACOMP
P.O. Box 162
Webster, New York, 14580
New York State residents please add 7% NYS sales tax.



Circle 155 on inquiry card.

Event Queue

Technical Programs, The Hartford Graduate Center, 275 Windsor St, Hartford CT 06120. These courses are aimed at technical professionals, and include such topics as computer system fundamentals, microprocessors, computer-aided graphics, solar energy systems, calculators, and more. Contact The Hartford Graduate Center for more information.

Datapro Research Corporation. Among the topics scheduled during the spring Datapro conferences are data communications, data base management systems, word processing, electronic mail, systems analysis and design, and many others. Contact Datapro, 1805 Underwood Blvd, Delran NJ 08075, for a schedule of the conferences.

Technology Transfer Institute. For a complete list of many courses being offered around the country during the spring of 1980, write to Technology Transfer Institute, POB 49765, Los Angeles CA 90049, or call (213) 476-9747.

Data Communications Conferences. These conferences will include symposia on local computer networks, European Data Communications Standards, understanding the components of data communications networks, data communications architecture, interfaces and protocols, and more. For a list of dates and further information, contact The McGraw-Hill Conference and Exposition Center, 1221 Avenue of the Americas, Rm 3677, New York NY 10020, or call (212) 997-4930.

APRIL 1980

April 1-2

Southeast Printed Circuits and Microelectronics Exposition, Sheraton-Twin Towers Convention Center, Orlando FL. This show is a specialized event devoted entirely to the packaging, production and testing of printed circuits, multilayers, semiconductor devices, and hybrids. The conferences are aimed at electronics specialists. Contact ISCM, 222 W Adams St, Chicago IL 60606.

April 9-11

The Practical APL Conference, Washington DC. This conference is addressed to business executives and systems designers. For more information, contact Joan Gurgold, STSC, 7 Holland Ave, White Plains NY 10603.

April 9-11

International Conference on Acoustics, Speech, and Signal Processing, Fairmont Hotel, Denver CO. The IEEE Acoustics, Speech and Signal Processing Society is sponsoring this conference devoted to experimental and theoretical aspects of signal processing, speech, and acoustics. For more information, contact IEEE, 1100 14th St, Denver CO 80202.

April 11-12

10th Annual Virginia Computer Users Conference. This conference is sponsored by the Virginia Tech Association for Computing Machinery (ACM) student chapter. The topics of discussion will be programming languages and system and personnel management. For more information, contact VCUC10, 562 McBryde Hall, VPI&SU, Blacksburg VA 24061.

April 12

Computer Fair, Scottish Rite Temple, 1895 Camino Del Rio South, San Diego CA. Exhibits and presentations of computers in education and the home are the highlights of this show which is sponsored by the San Diego Computer Society. For information, contact Richard Lindberg, POB 81537, San Diego CA 92138.

April 13-16

A Gateway to the Use of Computers in Education, Chase Park Plaza Hotel, St Louis MO. The purpose of this convention is to provide a forum for the exchange of information and ideas between individuals, to inform educators of developments in computer technology, and to expose participants to innovations in computing which can be utilized in the field of education.

Educators are encouraged

to exhibit and make presentations of instructional microprocessor materials during the convention. Contact the Association for Educational Data Systems (AEDS), POB 951, Rolla MO 65401.

April 14-18

The 6th Annual Reliability Testing Institute, Ramada Inn, 404 N Freeway, Tucson AZ. The objective of the course is to provide reliability engineers, product assurance engineers, and managers with a working knowledge of analyzing component, equipment, and system performance, and failure data to determine the distributions of their times to failure, their failure rates, reliabilities, small sample size, and more. Three continuing education credits are offered. The price for the course is $495. Contact Dr Dimitri Kececiouglu, Institute Director, Aerospace and Mechanical Engineering Dept, University of Arizona, Building 16, Tucson AZ 85721.

April 14-18

High-Speed Computer Organization, 6266 Boelter Hall, UCLA Extension, Los Angeles CA. This course is for computer designers, system architects, project leaders and managers. The course provides an understanding of the principles of high-speed computer organization and their use in cost-effective systems. Several designs for high-speed computers are presented and compared.

For more information, contact the UCLA Extension at POB 24901, Dept K, UCLA Extension, Los Angeles CA 90024.

April 19-20

Trenton Computer Festival, Trenton State College, Trenton NJ. Thirty speakers, user group demonstrations, conference sessions, and forums will be featured. The Trenton Conference has gained an excellent reputation in the past. This year it will cover computers in the home, education, medicine, music, and the arts. Admission is $5 for the two days. Contact Dr Allen Katz, Trenton State College, Hillwood Lakes, POB 940, Trenton NJ 08625, or Sol Libes, Amateur Computer Group of NJ, UCTI, 1776 Raritan Rd, Scotch Plains NJ 07076.

April 21-25

National Micrographics Association 29th Annual Conference and Exposition, Sheraton Center Hotel and Coliseum, New York NY. The theme for the show is "Focus on Productivity in Office Management." Highlighting the conference and exposition will be presentations and talks concerning the use in offices for computer systems and related items.

For more information, contact the Conference Dept, National Micrographics Association, 8719 Colesville Rd, Silver Spring MD 20910.

April 22-25

Spring DECUS US Symposium, Hyatt Regency O'Hare and the O'Hare Exhibition Center, Chicago IL. Exhibitions of Digital Equipment Corporation systems will be featured, along with special speakers and papers. Contact DECUS, Digital Equipment Computer Users Society, Attn: US Chapter, One Iron Way, MR2-3/E55, Marlboro MA 01752.

April 23-25

International DP Training Conference, Hyatt Regency, Chicago IL. The theme for this event will be "The 1980s: The Information Decade." The conference is a symposium for data processing experts and corporate training executives. For information, contact Deltak Inc, 1220 Kensington Rd, Oak Brook IL 60521.

April 26 and 30

The Computer-Aided Physician's Office, Academy of Medicine, 288 Bloor W, Toronto, Canada. The course will enable the private practitioner to evaluate the effectiveness of small computer systems and their potential to reduce or contain costs. The cost is $225 per day or $400 for both days. Contact Human Computing Resources Corp, 10 St Mary St, Toronto, Ontario, M4Y 1P9 CANADA.

April 27-30

The 17th Numerical Control Society Annual Meeting and Technical Conference, Hartford Civic Center, Hartford CT. This convention will offer technical sessions covering such areas as computer-aided design engineering, business management, tool design and graphics; computer-aided assembly, facilities planning, inventory control, and management information systems; numerical control in various areas; data base structure and management; and other educational programs. There is also a large exhibition being presented.

For more information, contact Numerical Control Society, 1800 Pickwick, Glenview IL 60025.

April 28-30

Managing Technical Programs and Projects, White Plains NY. For more information, contact the Institute for Advanced Professional Studies, One Gateway Ctr, Newton MA 02158.

April 30-May 2

Computerized Office Equipment Expo, O'Hare Exposition Center, Rosemont IL. The latest developments in computers, word processors, copiers/duplicators, telephone systems, and other business equipment will be featured. The seminars will cover guidelines on buying computer systems, telephone and copier systems, the use of word processors, and more. Contact Industrial and Scientific Conference Management Inc, 222 W Adams St, Chicago IL 60606.

MAY 1980

May and June

Microprocessor Training Courses, Cudham Hall, Cudham, Sevenoaks, Kent, England. The courses being offered by the Sira Institute Ltd are microprocessor familiarization, microprocessor applications for the equipment user and for the manufacturer, and microprocessor-based equipment design and development. Write to Conference and Courses Unit at Sira Institute Ltd, South Hill, Chislehurst, Kent BR7 5EH ENGLAND.

May

IEEE Computer Society Conferences and Meetings. For a list of events, contact the Executive Secretary, Harry Hayman, POB 639, Silver Spring MD 20901, or phone (301) 439-7007.

May 5-11

Engineering, Science, and Public Policy, 16th Annual Meeting, Baltimore Convention Center, Baltimore MD. Companies from around the world and the US will be exhibiting. The conference is being sponsored by the American Institute of Aeronautics and Astronautics (AIAA). Contact Lawrence Craner, Director of Technical Displays, AIAA, 1290 Avenue of the Americas, New York NY 10019, or the Conference General Chairman, Laurence Adams at Martin Marietta Aerospace.

May 6-8

Micro/Expo 80, Centre International de Paris, Paris France. This is one of the leading shows in Europe for microcomputer users and manufacturers. Exhibits of new equipment, presentations, games, educational materials, and more will be featured. For more information, contact Sybex Inc, 2020 Milvia St, Berkeley CA 94704.

May 6-8

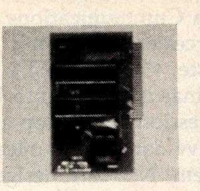
The 7th International Symposium on Computer Architecture, La Baule France. This symposium will consist of discussions and readings in the following areas: distributed architectures, special-purpose architectures, hardware description languages, fault-tolerant architectures, high-speed computers, control schema, evaluation of architecture performance, and more.

Contact, Daniel E Atkins, Dept of Electrical and Computer Engineering, University of Michigan, Ann Arbor MI 48109.

May 6-10

The 8th Annual Canadian Association for Information Science, Toronto, Canada. Technology, commodity, and rights are the themes of this conference. Topics will cover information in the marketplace, information transfer and policy issues, right to access, new information technologies and applications, and other subjects. For more information, contact the Program Chairman, Eighth Annual CAIS Conference, Technical Information Centre, Bell Northern Software Research, 12th floor, 522 University Ave, Toronto,Ontario M5G 1W7 CANADA.

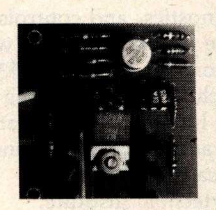
APPLE II PARALLEL INTERFACE CARD



John Bell Engineering is announcing an Apple II Parallel Interface Card. There are four I/O ports with handshaking logic. The board has two 6522 versatile interface adapters and a 74LS74 for addressing and timing. Each 6522 has two interval timers. This will interface your Apple II to printers, speech synthesizers, keyboards, and other John Bell Engineering products. Inputs and outputs are TTL and CMOS compatible.

Prices:
79-295 Complete kit $69.95
79-295 Assembled $79.95

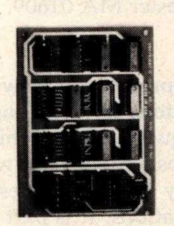
SOLID STATE SWITCH



Now you can control the World! Switch lights on and off for home security, computer controlled disco light shows. Turn your printer on only when needed. The Switch can handle 720 watts (120 VAC 6 AMPS). Its input is TTL compatible (5V-2MA), isolation 1500VDC. The circuit board is 2" square on the one channel kit and 2"x 8" on the 4 channel unit.

Prices:
1 Channel kit $9.95 assm. $12.50
4 Channel kit $34.95 assm. $44.95

A to D D to A CONVERTER



John Bell Engineering now has available an Analog to Digital and Digital to Analog Converter Board. Featues low cost medium speed (50,000 conversions per second) for applications such as speech recording and music synthesizing. Single power (+5) required. Parallel inputs and outputs include 8 data bits, strobe lines, and latches. Analog inputs and outputs are medium impedance zero to five volt range.

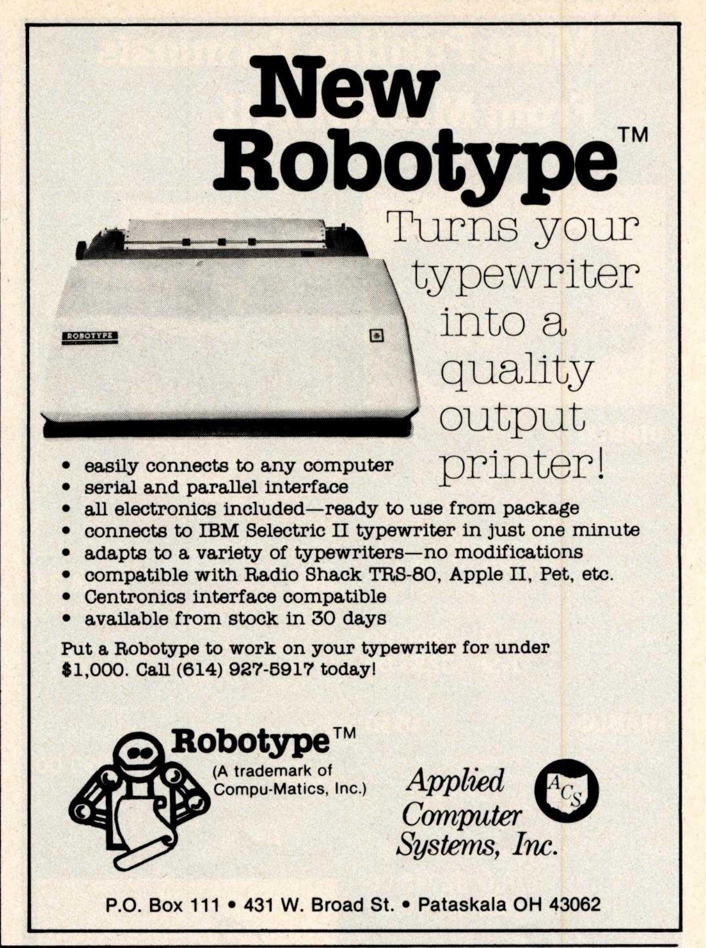
Prices:
79-287 Kit $49.95
79-287 Assembled $69.95

PRODUCTS AVAILABLE FROM:

JOHN BELL ENGINEERING
P.O. BOX 338
DEPT. 4
REDWOOD CITY, CA 94064
(415) 367-1137

ADD 6% SALES TAX IN CALIFORNIA AND $1.00 SHIPPING & HANDLING FOR ORDERS LESS THAN $20. ADD 4% FOR VISA OR M.C.

J B ENGINEERING







May 12-13

Data Communications, Worcester Polytechnic Institute, Worcester MA. This seminar is designed to help professionals develop an effective data communications system. Network design, requirements, software, diagnostics, and controls are some of the issues that will be covered. The fee is $375, which covers everything except hotels. For information, contact Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609.

May 13-15

Microprocessors: New Directions for Mankind, Albuquerque NM. This symposium will deal with a variety of microprocessor applications. It is part of the Ideas in Science and Electronics Show. Contact J Arlin Cooper, Div 2331, Sandia Laboratories, Albuquerque NM 87185.

May 13-15

Electro/80 Show and Convention, Hynes Auditorium and Boston Sheraton, Boston MA. This major show consists of presentations and exhibitions by manufacturers in the electronics and computer industries. Contact Electronic Conventions Inc, 99 N Sepulveda Blvd, El Segundo CA 90245.

May 13-16

The 9th Annual Conference of MUMPS Users Group, Islandia Hyatt House, San Diego CA. The meeting will bring together scientific, medical, and business professionals to discuss current research and application development in the use of MUMPS, a high-level language. Areas of participation include paper presentations, workshops and tutorials, and vendor exhibits. Contact Dr Jack Bowie, MUG 80 Program Chairman, The Mitre Corp, Mail Stop 641, 1820 Dolley Madison Blvd, McLean VA 22102.

May 14-16

Carnahan Conference on Crime Countermeasures, Carnahan House, Lexington KY. This conference is devoted to the application of engineering and science to law enforcement, security, and crime prevention. Emphasis will be on effective research and development in computer security.

Contact the Office of Continuing Education, College of Engineering, University of Kentucky, Lexington KY 40506.

May 19-22

1980 National Computer Conference, Anaheim Convention Center, Anaheim CA. The conference program will include more than 120 sessions covering computing careers and education, office automation, and auditing in the area of management; computers in earth resource management, human services, and word processing; programming languages, design techniques and methodology, and voice simulation and recognition in software; earth resources, education, women and minorities in the computing discipline, as well as social implications; microcomputers and minicomputers, computer architecture, and new concepts in memories.

For information, contact American Federation of Information Processing Societies Inc, 1815 N Lynn St, Arlington VA 22209.

May 21-22

The 2nd Clemson Small Computer Conference, Clemson University, Clemson SC. This conference will discuss applications in engineering, science, manufacturing, small business data processing, and education. Contact William J Barnett, Electrical and Computer Engineering Dept, Riggs Hall, Clemson University, Clemson SC 29631.

May 21-23

Business and Personal Computer Sales-Expo 80, Philadelphia Civic Center, Philadelphia PA. This show is aimed at a wide range of interests in business and other fields that use com-

A Message to our Subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers promotional material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to BYTE Publications Inc, Attn: Circulation Department, 70 Main St, Peterborough NH 03458. Thank you.

puters and computer related products. Exhibitors will be giving demonstrations of equipment. Contact Produx 2000 Inc, Roosevelt Blvd and Mascher St, Philadelphia PA 19120.

May 23

The Digital Computer Association Annual Meeting, Pacifica Hotel, 6161 Centinela Blvd, Culver City CA. A slide show, followed by dinner and an evening program are the main events of the meeting. The price is $15 prepaid. Send reservations to Mary Rich, 731 Bayonne St, El Segundo CA 90245.

May 24-25

Amateur Radio and Computer Hobbyists Annual Convention, Cervantes Convention Center, St Louis MO. Speakers, presentations, equipment displays, and a flea market will be featured. For more information, contact the Gateway Amateur Radio Association Inc, POB 68, Marissa IL 62257.

JUNE 1980

June 2-5

The 9th Annual Symposium on Incremental Motion Control Systems and Devices, Ramada Inn, Champaign IL. Exhibition space is available for this conference. Contact Professor B C Kuo, POB 2772, Station A, Champaign IL 61820.

June 4-5

Microprocessors: Hardware, Software, and Application, Holiday Inn, Boston MA. This course is recommended for technical professionals who need an understanding of microprocessors in relation to their corporate and business careers. Contact Office of Continuing Education, Worcester Polytechnic Institute, Worcester MA 01609.

June 4-6

Salon de l'Ordinateur Computer Show, Place Bonaventure, Montreal, Canada. This exhibition will feature over eighty manufacturers' hardware and software.

For more information, contact Industrial Trade Shows of Canada, 36 Butterick Rd, Toronto, Ontario M8W 3Z8 CANADA.

June 9-13

Microcomputer Workshop, Carnegie-Mellon University, Pittsburgh PA. Engineers, research scientists, educators and managers will benefit from this course. It covers all aspects of microcomputers and software. Hands-on training will be provided. The tuition is $585 and housing can be arranged. Contact the Post College Professional Education, Carnegie-Mellon University, Pittsburgh PA 15213.

June 15-18

International Summer Consumer Electronics Show, McCormick Pl, McCormick Inn, and the Pick-Congress Hotel, Chicago IL. The Consumers Electronic Show (CES) will feature exhibits from many companies; seminars and discussions; and items ranging from television, tape recorders, telephones, translators, to computers, component systems, auto sound systems, and electronic games will be presented. Contact Consumer Electronics Shows, Two Illinois Center, Suite 1607, 233 N Michigan Ave, Chicago IL 60601.

June 17-19

Data Comm, Palais des Expositions, Geneva Switzerland. Data communications and distributed data processing are the main themes of this conference and exhibition. Software development and tools, computer languages, managing data communications systems, and definitions, concepts, and applications of data communications and distributed data processing are some of the topics that will be covered in the conference.

For more information, contact Industrial and Scientific Conference Management Inc, 222 W Adams St, Suite 999, Chicago IL 60606.

June 18-21

Association for Computational Linguistics, University of Pennsylvania, Philadelphia PA. The meeting will cover theoretical and methodological problems of computational linguistics, speech acts, analysis of multisentence texts, dialog, machine translation and computational semantics. For further information contact Don Walker, Artificial Intelligence Center, SRI International, 333 Ravenswood Ave, Menlo Park, CA 94025.

June 20-22

The 5th Annual Computerfest, Franklin University, Columbus OH. Sponsored by the Midwest Affiliation of Computer Clubs, this is a gathering of interested hobbyists, professionals, and business-oriented computer users. Workshops and discussions are the main feature of the conference. Contact James Crowley, 4008 Rickenbacker Ave, Columbus OH 43213.

June 23-27

First World Conference on Transborder Data Flow Policies, Rome, Italy. Legal and social implications, economic dimensions, regulatory environment, interdependence caused by global communications, and assessing the status of data flow developments are some of the topics that will be covered in this forum. Write to the Intergovernmental Bureau for Informatics, POB 10253, 00144 Rome, ITALY. ■

In order to gain optimum coverage of your organization's computer conferences, seminars, workshops, courses, etc, notice should reach our office at least three months in advance of the date of the event. Entries should be sent to: Event Queue, BYTE Publications, 70 Main St, Peterborough NH 03458. Each month we publish the current contents of the queue for the month of the cover date and the two following calendar months. Thus a given event may appear as many as three times in this section if it is sent to us far enough in advance.

Build a Low-Cost EPROM Eraser

L B Golter
2702 Skyline Dr
Grand Junction CO 81501

The common 1702A, 2708, and 2716-type erasable programmable read-only memory devices (EPROMs) may be erased dozens of times and then reprogrammed, changing the internal bit pattern. The erasure is accomplished by exposing the silicon die to short-wavelength ultraviolet light through the quartz window. (The wavelength of the ultraviolet radiation in this instance is 2537 Å.) National Semiconductor's recommended integrated dose (intensity times exposure) is 6 Ws/cm^2 (Watt-seconds per square centimeter). They recommend also that the exposure be triple the time for erasure found empirically.

Light in the proper section of the ultraviolet spectrum for performing the erasure can be produced by several methods: molecular excitation, filtering of broad spectrum light, and fluorescence. The most economical way for generating a lot of ultraviolet light is by excitation, with or without filtering.

Common low-pressure fluorescent lamps excite mercury vapor to produce ultraviolet light. This light causes rare earth compounds on the tube walls to fluoresce in the visible spectrum.

Several companies manufacture a low-pressure mercury vapor tube without the fluorescent rare earth compounds. Such tubes emit a high-intensity, short wavelength ultraviolet light. As a bonus, they are easy to use, are relatively inexpensive, and have a long life (about 6000 hours). However, do not look at one while it is on. The light can damage your eyes.

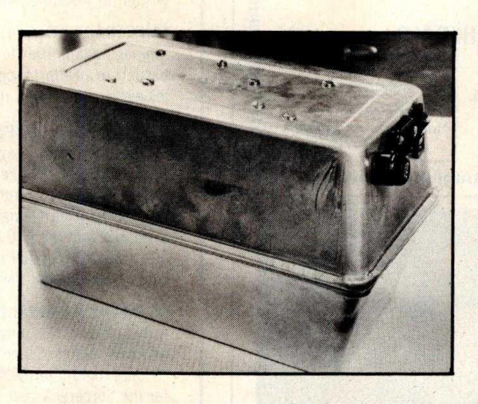


Photo 1: *The case for the EPROM eraser is made of two bread-baking tins hinged together with flexible material. Power supply components are mounted in one end of the upper tin.*

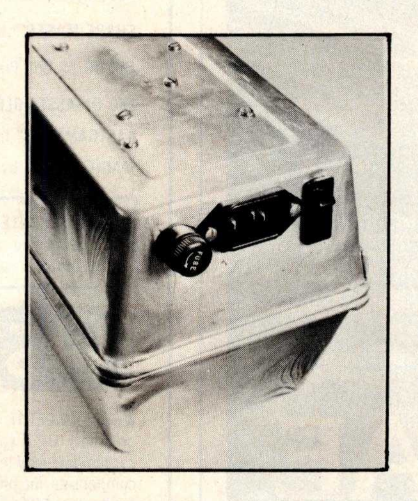


Photo 2: *Holes were cut to allow mounting of a fuse, a 3-prong connector, and a switch (with an internal neon pilot lamp).*

Construction

I set out to build an eraser for the erasable programmable read-only memories using one of the low-pressure, mercury-vapor ultraviolet tubes. As an enclosure for the device, I used two aluminum bread-baking tins with dimensions 24.5 by 14 by 7 cm (9⅝ by 5½ by 2¾ inches). I fastened the two tins together along the long side with a hinge made of flexible material. I cut holes in one end of the assembly to mount a fuse, a power switch, and a connector for power supply. Photo 1 shows the completed box; photo 2 shows a close view of the power control components mounted in their holes.

To provide strong support for the somewhat delicate ultraviolet lamp, I built a support for it on a piece of sheet aluminum cut to fit inside the bread tin with about 1.3 cm (one-half inch) clearance on each side. Two blocks of wood are attached by screws to the bottom of the tin and support the sheet of aluminum. The lamp tube is supported and raised about 2.5 cm (an inch or so) off the surface by a combination of standoff insulators and cable tie-down

devices. Photo 3 shows the tube mounted on its support structure.

Electrical power is supplied to the lamp through wires soldered to each of the miniature 2-pin contacts on the ends of the lamp. Because a potentially deadly voltage is present on the pins whenever the unit is plugged in, I insulated the pins thoroughly with heat-shrink tubing and silicone sealant. The wires were fed through holes in the aluminum baseplate/reflector.

Electrical Assembly

Figure 1 shows a schematic diagram of the electrical connections needed to operate the lamp. The remaining electrical components are mounted in the bread tin under the support plate of the lamp. The ballast and starter mechanism are secured to the tin with screws. The bread tins are connected to ground through the 3-conductor power cord; this is an important step to assure safety. Be sure that both halves of the case are grounded. Also, be careful to direct the hot side of the power line to the fuse and switch. An 82 k-ohm resistor limits the current in the circuit of the

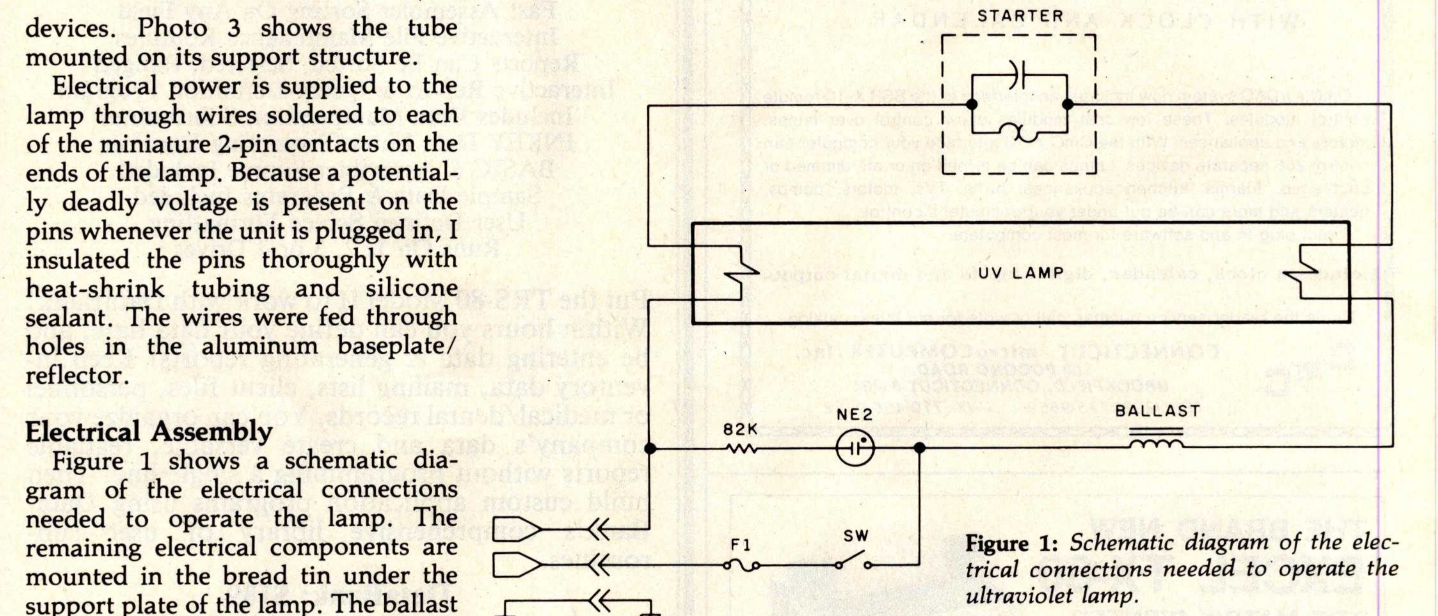


Figure 1: *Schematic diagram of the electrical connections needed to operate the ultraviolet lamp.*

1 F6T5/BLB	6 watt ultraviolet lamp
1 89G435 (General Electric)	4,6,8 watt ballast
1 FS-5	Fluorescent lamp starter 4,6 or 8 watt
1 #380 (Leviton)	Starter Socket
2 (9⅝ x 5½ x 2¾) aluminum bread tins	

Miscellaneous wire, hardware, hinges, switches, fuse, and IEC cord and socket.

Table 1: *List of parts needed to build this EPROM eraser.*

Circle 175 on inquiry card.



Circle 177 on inquiry card.

CAT-100 FULL COLOR GRAPHICS

The original 256-color imaging system with high resolution video FRAME GRABBER for the S-100 bus.

Capture and digitize a video frame in 1/60 of a second. Select the best resolution for your application, from 256 to 1280 pixels per TV line. Display your digitized or computer processed image with 256 gray levels or 256 colors on standard B&W, NTSC or RGB color TV monitors.



240x256 Digitized image, 16 levels

480x512 Computer-generated

Compact two-board basic system

Features:

- Highest possible quality 480x512x8 digital video image presently available on the market
- Input capability from TV camera or other sources
- Variety of synchronization choices
- 2 selectable video A/D conversion circuits
- Choice of 1, 2, 4, 8, 16 or 32 bits per pixel
- 32K-byte image memory on the basic system
- 32, 64, 128 & 256K byte system capacity
- Lightpen input
- Photographic trigger control input
- Software selectable system parameters
- Interfaces for TRS-80 and other processors
- Comprehensive line of accessories, monitors and support software

SEND FOR FREE CATALOG



DIGITAL GRAPHIC SYSTEMS
441 California Ave., Palo Alto, CA 94306 415/494-6088

PROFESSIONAL CP/M* SOFTWARE

These are superb professional quality implementations usually found on larger computers. Thorough documentation accompanies every DataArt product so you will be *"up and running"* immediately. In addition, all packages are delivered with CRT drivers for your terminal.

SOFTWARE PRODUCT †	CBASIC	Microsoft® COBOL	Microsoft® BASIC
● Payroll	$250	$500	$350
● Accounts Receivable	250	500	350
● Accounts Payable	250	500	350
● General Ledger	250	500	350
● Bowling Secretary	350	350	350
● Program Chain Utility	95	95	95
● CRT Manager Utilities	250	250	250
● Data Communications	contact us - many protocols available		

Accounting packages based on Osborne Publications.

* CP/M is a trademark of Digital Research Corporation.
† Many software packages also available for North Star Computers.

"where software is still an art"

DataArt Inc.
21162 Lorain Road
Fairview Park, Ohio 44126
(216) 333-2232

Circle 176 on inquiry card.

6809!

INTRODUCING THE NEW STATE-OF-THE-ART IN MICROCOMPUTER SOFTWARE.

Call or write today for our free catalog.

MICROWARE

5835 Grand Ave. • P.O. Box 4865
Des Moines, IA 50304 • 515/279-8844

Circle 302 on inquiry card.

NE-2 pilot lamp in the switch. Photo 4 shows the components mounted in the bread tin among the baseplate supports.

I tested the device with a standard ohmmeter, checking for high resistance across the power plug. Having found this, I subjected the apparatus to a successful smoke test (that is, no smoke). I observed the starter takes 5 seconds or less to ignite the lamp in normal operation.

Conclusion

When operating the erasing device, it is a good idea to wrap opaque tape around the crack between the two bread tins. This should prevent possibly harmful ultraviolet radiation from leaking out and damaging your vision. Remember also, for safety's sake, that careful insulating of high voltage lines and grounding of all parts is very important.

I started to make a table of exposure indices for various erasable read-only memory devices, but I found that 30-minute exposure completely erased all bits in my tests, so I feel that this exposure interval is adequate.

In operation, the device is placed so that the lamp is in the upper half. The memory integrated circuits are placed in the empty lower half for exposure. An added benefit of this empty half is that it makes a convenient storage location for the detachable power cord between the times that you erase your memories. ■

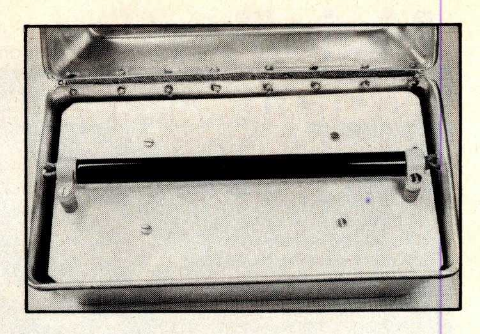


Photo 3: *The ultraviolet lamp tube is supported on its aluminum baseplate by insulating standoffs and cable ties.*

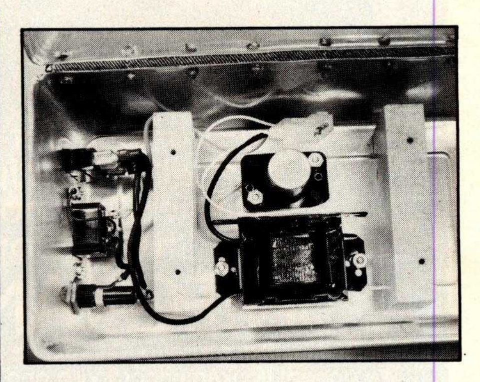


Photo 4: *Blocks of wood support the lamp baseplate. Between the blocks are mounted the lamp starter and ballast devices.*

Editor's Note

Ultraviolet light can damage your eyes, so it is important to avoid looking at a source of it while in operation. Observe due caution when operating the erasing device described in this article.

Over several cycles of programming and erasure, the necessary erasure exposure of certain EPROM devices can increase. Thus, over a period of time you may have to lengthen exposure times to obtain good results.

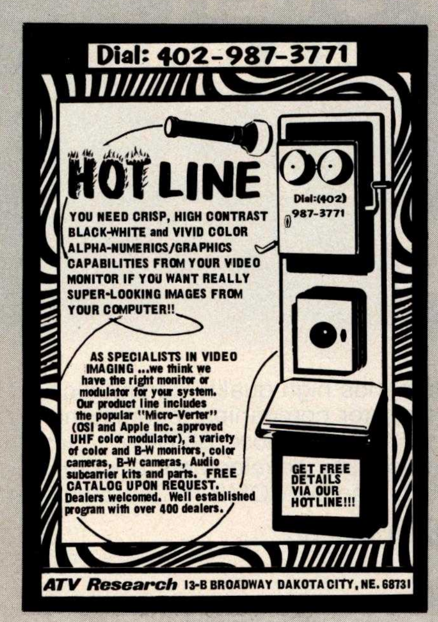
*You may find more information about erasable read-only memory characteristics in "Program Your Next EROM in BASIC" by Steve Ciarcia (March 1978 BYTE, page 84), and "Zapper: A Computer Driven EROM Programmer" by G H Gable (December 1978 BYTE, page 100)....*RSS

Circle 179 on inquiry card.

Circle 180 on inquiry card.

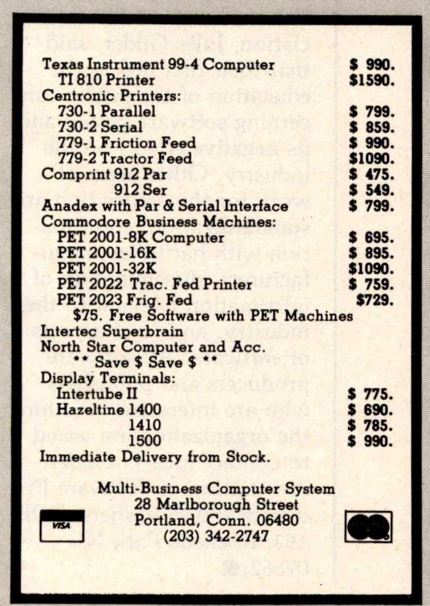
Circle 181 on inquiry card.

Circle 182 on inquiry card.



Circle 183 on inquiry card.

Circle 184 on inquiry card.



Texas Instrument 99-4 Computer	$ 990.
TI 810 Printer	$1590.
Centronic Printers:	
730-1 Parallel	$ 799.
730-2 Serial	$ 859.
779-1 Friction Feed	$ 990.
779-2 Tractor Feed	$1090.
Comprint 912 Par	$ 475.
912 Ser	$ 549.
Anadex with Par & Serial Interface	$ 799.
Commodore Business Machines:	
PET 2001-8K Computer	$ 695.
PET 2001-16K	$ 895.
PET 2001-32K	$1090.
PET 2022 Trac. Fed Printer	$ 759.
PET 2023 Frig. Fed	$729.
$75. Free Software with PET Machines	
Intertec Superbrain	
North Star Computer and Acc.	
** Save $ Save $ **	
Display Terminals:	
Intertube II	$ 775.
Hazeltine 1400	$ 690.
1410	$ 785.
1500	$ 990.
Immediate Delivery from Stock.	

Multi-Business Computer System
28 Marlborough Street
Portland, Conn. 06480
(203) 342-2747

VISA

Circle 185 on inquiry card.

Circle 186 on inquiry card.

Circle 187 on inquiry card.

BYTE's Bits

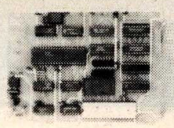
Bentley College Needs Computer Teachers

In 1979, Bentley College began offering a Master of Science degree in Computer Information Systems and expanded its undergraduate degree program. The college is seeking applications from individuals who have a commitment to teaching excellence. Candidates must have knowledge of at least two of the following areas: ANSI COBOL, BASIC, RPG II, FORTRAN, distributed information systems processing, data communication, file organization and structures, computer auditing and controls, and business systems analysis and design. A completed doctorate or one near the final stages of completion is preferred. The teaching responsibilities will include nine to twelve hours of computer information systems at the graduate and/or undergraduate levels. For information, address John T Gorgone PhD, Professor and Chairman, Computer Information Systems Dept, or Dr John H Burns, Dean, Bentley College, Waltham MA 02154.

Quality Research Group for Software

An organization to serve the needs of the software industry has been formed. The goal of the Association of Software Producers and Publishers is to ensure the continuing availability of well-supported, quality software to computer users by providing a forum where common industry problems can be discussed and possible solutions can be offered. The chairman of the association, Jules Gilder, said that their first task is the education of the public concerning software piracy and its negative effects on the industry. Other areas of work for the association are standardization, coordination with hardware manufacturers, dissemination of information relevant to the industry, and legal aspects of software. All software producers and publishers who are interested in joining the organization are asked to contact Jules H Gilder, Association of Software Producers and Publishers, POB 153, Rochelle Park NJ 07662. ■

New from
Vantage Data Products
550 West 200 South
Suite 8
Provo, Utah 84601
(801) 377-6687



Communications/Control CPU Card

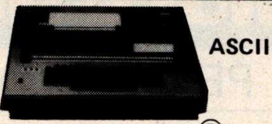
- **CPU** -Z-80 1K RAM
  16 bit interval timer and interrupt
  EPROM* 2708 standard (2716 optional)
- **Serial Communications**-RS-232 interface, UART Complete MODEM capability, programmable baud rates, etc.
- **Parallel I/O** - 16 bits in (TTL), 16 bits Out (TTL)
- Power - on and external reset
  *EPROM not included

$195 assembled, tested, with warranty and documentation

Immediate delivery from stock!
All orders shipped prepaid
MC, VISA, phone orders welcome
Utah residents add 4¾/sales tax

Circle 190 on inquiry card.

SURPLUS ELECTRONICS

ASCII  **ASCII**

IBM SELECTRIC ®
BASED I/O TERMINAL
WITH ASCII CONVERSION
INSTALLED $645.00

- Tape Drives • Cable
- Cassette Drives • Wire
- Power Supplies 12V15A, 12V25A, 5V35A Others, • Displays
- Cabinets • XFMRS • Heat Sinks • Printers • Components

Many other items, SEND $1.00 FOR CATALOG REFUNDABLE FIRST ORDER
WORLDWIDE ELECT, INC.
130 Northeastern Blvd.
Nashua, NH 03060
Phone orders accepted using
VISA or MC
Call 603-889-7661

Circle 191 on inquiry card.

Floppys & Systems Repair

DRIVES

- *Per Sci - Shugart*
- *Pertec - Micropolis*

COMPUTERS

- *Apple - TRS-80*

Computer Service Center
1023 N. La Brea
Hollywood, CA 90038
(213) 851-2226

Circle 192 on inquiry card.

GET CONNECTED

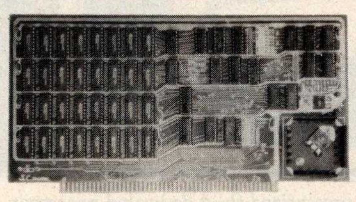
Connect your S-100 BUS or TRS-80 system to the telephone network and *turn it into a terminal.*
The μ-Phone© is absolutely all you need — it's not just a modem, not just a controller.

Just plug the μ-Phone© into your processor and plug it's cable into a standard modular telephone wall jack and you're connected.

The μ-Phone© is BELL 103 compatible and F.C.C. registered.

Another Fine Idea From
I.D.E.A.
850 Lexington St.
Waltham, MA 02154
617-893-1368

Circle 193 on inquiry card.



16K STATIC MEMORY (RAM)

250 nsec Access Time, Assembled, tested, and Guaranteed. $285.00

Fully Static - TMS 4044
S-100 Bus - Buffered lines, Dip Sw address in 2, 8K blocks 4K incr., Write Protect, Phantom disable, Battery backup, fully Socketed.
Bank Select - Port 40H (Cromemco Software Comp.), 80H or C0H.
Guarantee - One full year. To order, call for Visa, M.C., or C.O.D. ($4 fee.) Personal check o.k. M.O. speeds shipping. Stock to 72 hour delivery. Illinois residents add 5¼% tax.

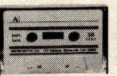
S. C. DIGITAL
P.O. Box 906, Aurora, IL 60507
Phone: (312) 897-7749

Circle 194 on inquiry card.

CASSETTE DUPLICATION

TRS-80 (I & II), PET, APPLE, KIM, ATARI

Quality software duplication is more than copying cassettes. Microsette duplication uses a proprietary high speed duplicator designed specifically for computer program duplication. The finished products are of consistent quality, guaranteed to load. Minimum order is 100 with discounts for higher quantities. Call (415) 968-1604 for details.

MICROSETTE CO.
475 Ellis Street
Mt. View, CA 94043

Circle 195 on inquiry card.



The best choice in mainframes !

- S100 CARD FRAME
- 22 MHz 12" CRT MONITOR
- 18 AMP POWER SUPPLY
- UPPER & LOWER CASE ASCII KEY BOARDS
- AXIAL BLOWER
- ASSEMBLED & TESTED
- READY FOR YOUR CARDS
- $895.00 OEM QUANT. ONE

INFINITE incorporated ™

Celebrating Our 13th Year.
819 E. STRAWBRIDGE, MELBOURNE, FL 32901 – (305) 724-1588

Circle 196 on inquiry card.

16 K RAMS & RAM CONTROLLERS

16 K X 1 DYNAMIC RAMS MK4116P3
- 200 NSEC ACCESS/375 NSEC CYCLE TIMES
- 16 PIN/TTL COMPATIBLE
- ALL CHIPS BURNED IN AND FULLY TESTED
- PRICE WITH DATA SHEET
  $68.00 IN QTY OF 8/THAT'S $8.50 EACH

6800/6502 64K BYTE RAM & CONTROLLER SET
MAKE 64K BYTE MEMORY FOR YOUR 6800 OR 6502
THIS SET INCLUDES:
- 32 M5K 4116-3, 16K X 1, 200 NSEC RAMS
- 1 MC3480 MEMORY CONTROLLER
- 1 MC3242A MEMORY ADDRESS MULTIPLEXER AND COUNTER
- DATA & APPLICATION SHEETS. PARTS TESTED AND GUARANTEED.
  $295.00 PER SET

DYNAMIC MEMORY CONTROLLER MC3480L
- GENERATES RAS/CAS & REFRESH TIMING FOR 16K TO 64K BYTE MEMORIES
- PRICE WITH DATE SHEET: $13.95 EACH

MEMORY ADDRESS MUX/COUNTER MC3242AP
- MUX ADDRESS & REFRESH COUNTER FOR 16K TO 64K BYTE MEMORIES
- PRICE WITH DATA SHEET: $12.50 EACH

QUANTITY DISCOUNTS AVAILABLE

ALL ORDERS POSTPAID. U.S. FUNDS ON INTERNATIONAL ORDERS. CHECK OR MONEY ORDER, VISA/BA/MC ALSO ACCEPTED. SEND ACCT. NO., EXPIRATION DATE, & INTERBANK NO. WITH SIGNED ORDER. CALIF. RESIDENTS PLEASE ADD 6% SALES TAX. PHONE ORDERS: (714) 633-4460.

MEASUREMENT SYSTEMS & CONTROLS, INC.
MEMORY DEVICES DIVISION
867 NORTH MAIN ST., ORANGE, CA 92668

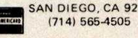
SUPPLIES



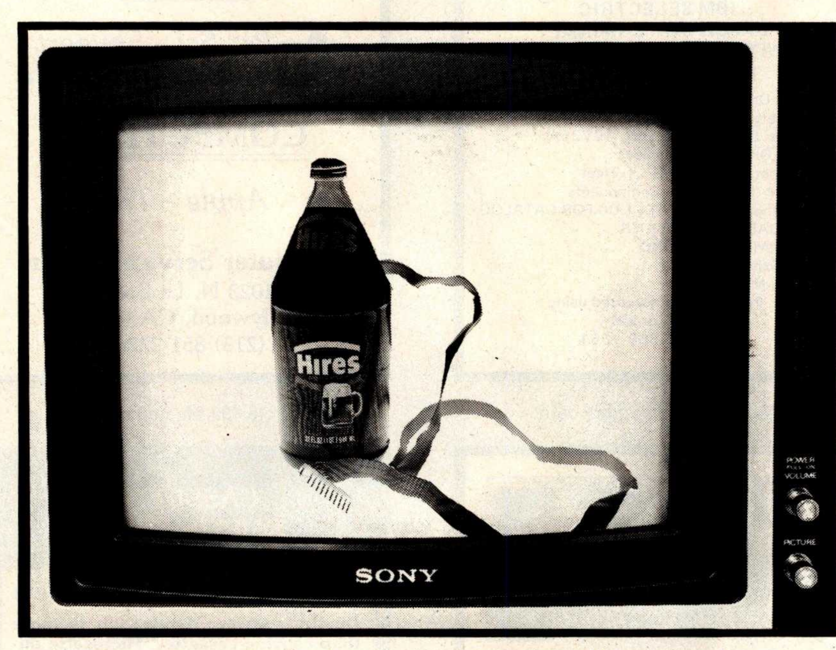
- FLOPPY DISKS, MINI OR STANDARD MEMOREX OR 3M
- 3M DATA CARTRIDGES DC300A, DC100A
- 3M DIGITAL CASSETTES
- 3M OR MEMOREX AUDIO CASSETTES, C-60
- 3M DISK CARTRIDGES

WE OFFER:
- COMPETITIVE PRICING
- IMMEDIATE DELIVERIES (Any Quantity)
- UNCONDITIONAL GUARANTEE

BETA BUSINESS SYSTEMS
8369 VICKERS ST., #G
SAN DIEGO, CA 92111
(714) 565-4505

Circle 198 on inquiry card.



The Root Beer Budget Hi-res Graphics Interface

An enhanced, high-resolution (hi-res) version of the graphics interface described by Peter Nelson in the November 1976 BYTE, this unit provides displays using a unique amorphous-silicon-dioxide and pressurized-fluid dedicated processor.

Color can be uniquely defined within 32 floating ocular-zones (32 fl oz), and resolution is specified to be at least 946 million lines (946 ml).

Contact Orphanode Hops Inc, POB 463, Peterburrow NH 03458, Attn: Duncan MacKenzie.

Circle 547 on inquiry card.

Floppy-Disk Drives with 96 Tracks Per Inch

Micro Peripherals Inc is producing 5-inch floppy-disk drives that read and write 96 tracks per inch. When combined with double data density and double-sided read/write features, the units can store nearly one megabyte on a 5-inch floppy disk. The Models 91 and 92 disk drives are plug-compatible with existing systems. Disks recorded on the standard 48-track-per-inch format can be read on the 96-track-per-inch devices. The Model 91 can store 480 K bytes on a single side of a disk, and the Model 92 can store 960 K bytes using both sides of the disk. Both have an access time of 5 ms.

The head assembly for the Model 92 incorporates a fixed bottom head with a gimballed top head. This assembly provides more than three million in-contact passes of the media over a single track. An automatic disk positioning and ejector mechanism pre-positions the disk over the spindle hub before the clutch centering device is engaged. The units are available from Micro Peripherals Inc, 9754 Derring Ave, Chatsworth CA 91311. The prices are $450 for the Model 91 and $550 for the Model 92.

Circle 548 on inquiry card.

Where Do New Products Items Come From?

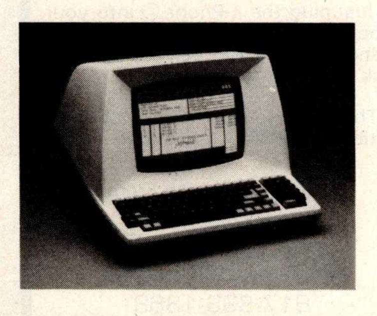
The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgement the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first in first out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

Joystick Interface for TRS-80

This joystick interface plugs into the expansion interface of the TRS-80 with no modifications. Three sockets allow the use of one Fairchild or two Atari joysticks for single or two-person interactive games and input. Both types of joysticks can sense eight compass directions; additionally, the Atari includes one push button, and the Fairchild features push-pull and twisting actions. Each interface comes with a separate power supply, two games and instructions on programming the interface. The price is $65 plus $3.50 shipping and is available directly from Creative Software, POB 4030, Mountain View CA 94040.

Circle 549 on inquiry card.

TeleVideo Introduces Four Video Terminals



TeleVideo Inc has introduced four microprocessor-controlled video terminals that include uppercase and lowercase, a printer port, numeric pad, remote computer control, selectable transmission rates from 75 to 9600 bits per second (bps), editing and other functions, a serial RS-232C interface, and a 20 mA current loop. Editing and transmission functions are key-selectable and include character and line insert or delete, line and page erase, send-line, send-page, and tabbing. All models also offer reverse-video, underline, blinking and blanking, key-controllable conversational and block transmission modes, a built-in self-test, protected fields, switch-selectable parity, and a 240-character input buffer. The terminals provide a 12 by 10 dot matrix in a 24-line by 80-character per line format.

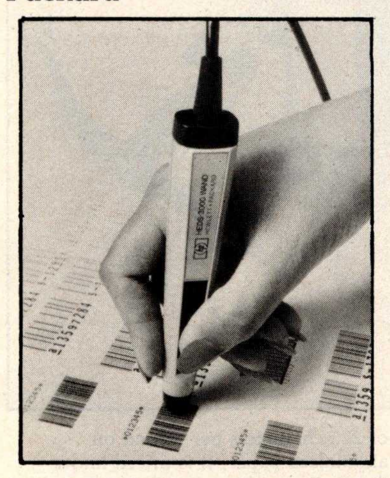
The 912B lists at $875, the 912C at $950, 920B at $945, and the 920C at $1030. For further information contact TeleVideo Inc, 3190 Coronado Dr, Santa Clara CA 95051.

Circle 550 on inquiry card.

What's New?

PERIPHERALS

Digital Output Bar-Code Wand from Hewlett-Packard



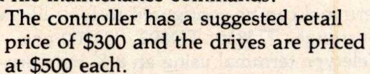
The HEDS-3000 is a digital wand designed to scan bar codes and output a logic level pulse-width representation of the bars and spaces. The device can be used for portable data entry and as peripheral equipment for microcomputers. An analog amplifier, a digitizing circuit, and an output transistor provide TTL- and CMOS-compatible logic level output. The bar-code reader is a data entry alternative to the keyboard as a computer terminal accessory. It is priced at $99.50. Contact Hewlett-Packard Co, 1507 Page Mill Rd, Palo Alto CA 94304.

Circle 551 on inquiry card.

New Peripherals for the TI-99/4 Computer

An RS-232 interface for connecting serial peripherals to the TI-99/4 computer has been announced by Texas Instruments Inc, Consumer Relations, POB 53, Lubbock TX 79408. The interface converts the parallel data output of the TI-99/4 to a serial format. Using BASIC, the interface can be programmed for different data transmission speeds. Connection to the two serial ports is through standard 25-pin male DB-25 connectors. The suggested retail price is $225.

A disk drive controller and a 5-inch floppy-disk drive have also been developed for use with the system. The system can store up to 90 K bytes of memory, and up to 127 files may be defined. The controller can handle fixed and variable length records, and sequential and relative files. Controller software supplies disk utilities, including disk and file maintenance commands.



The controller has a suggested retail price of $300 and the drives are priced at $500 each.



TI also has designed a thermal printer for use with the TI-99/4. The printer prints 32 columns in a 5 by 7 dot matrix at 30 characters per second (cps). It prints two character sets, and has 32 predefined graphic symbols. The unit uses 8.8 cm (3.5 inch) thermal paper and retails for $400.

A telephone modem has been designed for the system and the new interface. The modem is priced at $225, and a software support package is priced at $45.

Circle 552 on inquiry card.

Graphics Drawing System for Apple II



The VersaWriter is a digitizer and software drawing package for the Apple II computer. When used as a pointer, the VersaWriter can direct movements of objects on the video screen for game playing or creating graphics. As a digitizer, the VersaWriter enters graphical data for analysis, flowcharts and diagrams. Drawings, architectural plans, schematics charts, and graphs can be created using the device. Sixteen commands control cursor movement, permit fill-in coloring, control horizontal and vertical scaling, centering on the screen, and more. The system consists of the VersaWriter drawing board and interface, software, calibration chart, and instruction manual. The drawing board plugs directly into the game port. An Apple II with 32 K bytes of memory and Applesoft read-only memory are required.

The normal retail price for the VersaWriter is $199, but a special price of $179.95 is offered while initial supplies last. For complete information, contact Rainbow Computing Inc, 9719 Reseda Blvd, Northridge CA 91324.

Circle 553 on inquiry card.

Rack-Mounted Alphanumeric Printer

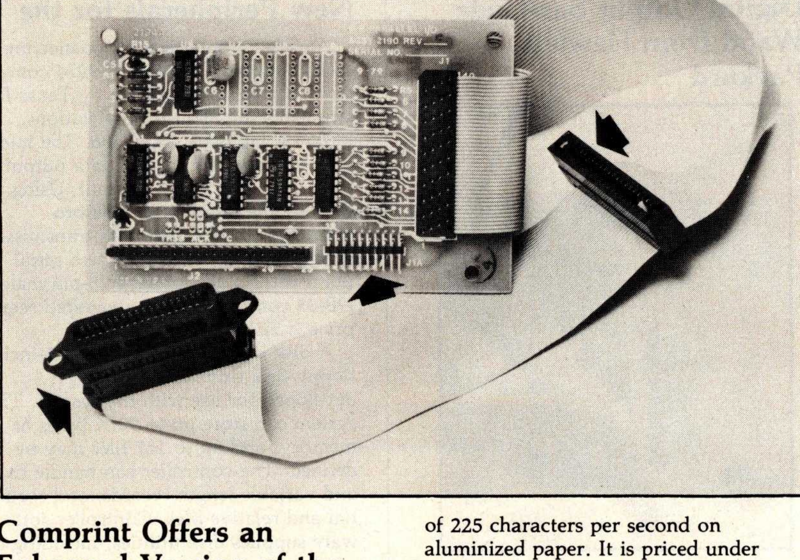
Kontron Electronic Inc, 700 S Claremont St, San Mateo CA 94402, has introduced the rack-mounted Model 5019 Printer, which features a 64-character ASCII set. Character width is generated by control logic and can be changed during the printing. The unit prints up to 32 characters per line at up to two lines per second with a 5 by 7 dot matrix. A parallel or serial ASCII input or fully parallel binary-coded decimal (BCD) input mode may be selected. The printer measures 13.2 by 21 cm (5.22 by 8.39 inches) and costs $235.

Circle 554 on inquiry card.

Video Terminal Emulates Burroughs Terminals

The SRI/OP1-R microprocessor-based terminal can be configured to look like a Burroughs TD830, TD802, TD700 or a Teletype terminal using an 8 K byte programmable read-only memory-based emulator. The SRI/OP1-R offers asynchronous, TDI, or synchronous communication interfaces at speeds ranging from 300 to 9600 bits per second (bps), and can interface with printers, bar-code readers, and other peripherals. The terminal can also support concurrent background printing, using a separate polling address which enables users to concurrently perform on-line entry functions while it prints output reports. The terminal is priced at $2595 and is available from Systems Research Inc, 2400 Science Pky, Okemos MI 48864.

Circle 555 on inquiry card.

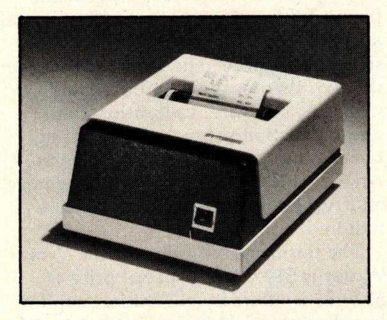


Comprint Offers an Enhanced Version of the 912: the Model 912-GP

The Comprint 912-GP electroresistive printer contains a feature that allows optional interfacing with nearly all of the microcomputers used in business, word processing, and personal applications, including the TRS-80 and the Apple II. The 912-GP is shipped with three separate connectors. The first is an Apple-compatible connector mounted on the board. Two additional connectors, one for the TRS-80 and the other for a Centronics-compatible port, are mounted on a flat ribbon cable attached to the board. The new printer provides a selection of four signals, which satisfy the requirements of most computers. This nonimpact printer prints at a speed of 225 characters per second on aluminized paper. It is priced under $1000. For additional information address Comprint, 340 E Middlefield Rd, Mountain View CA 94043.

Circle 556 on inquiry card.

Dot-Matrix Impact Printer for Small Business and Home Computers



The Model 7000+ dot-matrix impact printer features 1.25 lines per second unidirectional printing, with a line speed of 1.25 lines per second. It accepts single- or multi-ply paper rolls from 2.4 cm to 9.6 cm (0.75 to 3.85 inches) wide, and prints an 8.2 cm (3.3 inch) line. Capacity is 40 columns at 12 characters per inch. The 7000+ printhead has a minimum life of 100 million characters, while the overall mechanism life of the unit is 10 million cycles. The printer interfaces include TRS-80 parallel, Apple parallel, RS-232C, PET IEEE, current loop, and others. The 7000+ accepts the full ASCII character set with uppercase and lowercase and can print in both a single- or a double-width font. The printer measures 18 cm high (6.5 inches) by 25.5 cm wide (10 inches) by 32.5 cm deep (12.5 inches). It is made by LRC, an Eaton company, Technical Research Park, Riverton WY 82501, and is priced at $389.

Circle 557 on inquiry card.

Expansion Interface for The Imagination Machine

APF Electronics Inc, 444 Madison Ave, New York NY 10022, has announced Building Block, an expansion interface for their computer, The Imagination Machine. This interface is designed for interfacing printers, additional memory, modems, and floppy-disk drives. It includes a cartridge with a standard RS-232 port, which meets EIA RS-232 specifications. Eight data rates are selectable from 110 to 9600 bps. The suggested price for the Building Block is $199.95.

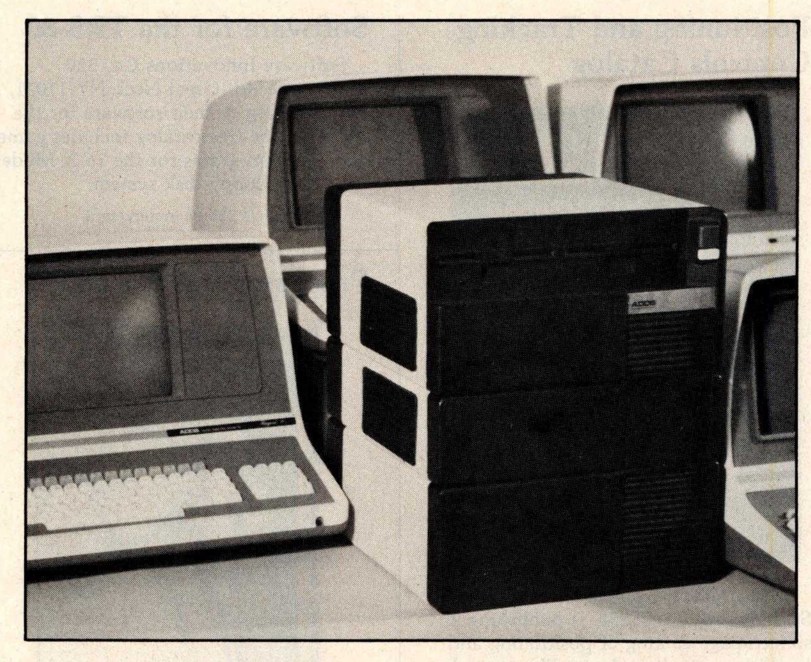
The 8 K byte programmable memory cartridge plugs into the interface and has a suggested retail price of $99.95. The floppy disk interface cartridge can drive two 5¼-inch floppy-disk drives and has a suggested price of $199.95. The D-100 5¼-inch floppy-disk drive has a storage capacity of 72 K bytes. It includes Shugart SA-400 compatibility, IBM formatting of 256 bytes per sector, and a built-in power supply. It retails for approximately $349.95. The P-40T 40-column thermal printer has a speed of two lines per second and a suggested price of $399.95. The TM-150 Modem transmits at 300 bps. It has originate and answer modes, and allows half- or full-duplex operation. An AC adapter is included for the package price of $199.95.

Circle 558 on inquiry card.

What's New?

SYSTEMS

ADDS Enters the Business Market with Modular Computer Systems



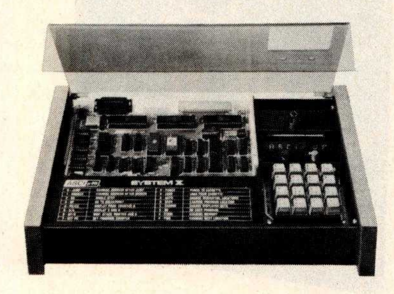
Applied Digital Data Systems Inc, 100 Marcus Blvd, Hauppauge NY 11787, has developed a modular microcomputer system for professional offices, agencies, retail stores, and other small businesses. The basic system, Multivision 1, contains an 8085 microprocessor running at 5 MHz, all input/output (I/O) and controller circuitry to operate the dual 5-inch floppy-disk drives, and a standard display terminal. Multivision 2 adds an 8-inch Winchester disk drive with either 5-megabyte or 10-megabyte storage. Multivision 3 supports up to four display terminals with up to 256 K bytes of programmable memory and three more terminal ports.

Some of the features of the central processing unit include: 256 bytes of nonvolatile (CMOS with battery power) memory for soft parameter control such as terminal data rates, stop bits, logging of diagnostic data, and applications use; direct memory access (DMA) capabilities for I/O to memory, memory to I/O, and memory-to-memory transfers. The unit also features 64 K bytes of dynamic programmable memory. All peripheral and interrupt control uses I/O hardware.

ADDS produces a CP/M-compatible operating system, a BASIC compiler and interpreter with ISAM capabilities, business applications software, and word processing software. The price for the three Multivision systems are $3785, $7995, and $12,885, respectively.

Circle 513 on inquiry card.

The μ68 System X Microprocessor



Based on the Motorola 6800 microprocessor, System X was designed for technicians, engineers, and scientists. It can be used as a training system, or as a development tool by designers for circuit designs and interfacing for industrial control and software development. The unit includes an 86-pin card edge connector for the microprocessor board and another connector for the memory board and lab series board. It features total compatibility with the Motorola EXORcisor bus. The price for the system is $775, and it is available from ASCI Marketing Group, Suite 101, 27439 Holiday Ln, Perrysburg OH 43551.

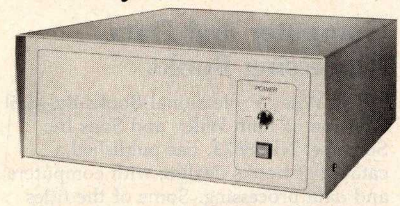
Circle 514 on inquiry card.

Single Board Microcomputer Uses 6809 Processor

The MIKUL 6809-3 is a single board computer that utilizes the Motorola MC6809 processor. The card includes two 6821 peripheral interface adapters, one 6840 programmable timer module, one 6850 asynchronous-communications interface adapter with RS-232C interface, 2 K bytes of static programmable memory with provision for battery backup, and sockets for four erasable programmable read-only memory (EPROM). The MIKUL 6809-3 is compatible with EXORciser and Micromodule buses. It is available for $425 from TL Industries, 2573 Tracy Rd, Northwood OH 43619.

Circle 515 on inquiry card.

S-100 Mainframe and Z80 Board with 64 K Bytes of Memory



CMC Marketing Corp, 10611 Harwin Dr, Suite 406, Houston TX 77036, has announced the Model 2018 Microcomputer Mainframe System. The system consists of an eighteen-slot S-100 bus motherboard and cabinet; a constant voltage transformer that provides for input voltages of 120 or 230 VAC; and a double-pole circuit breaker that protects the input power. Secondary voltages are rated at +8 VDC at 20 A and ± 16 VDC at 3.5 A.

The Model Z80/64 computer and memory card features a Z80 microprocessor and 64 K bytes of programmable memory, plus provisions for 2 K bytes of erasable programmable read-only memory and vectored interrupts. The board features transparent refresh and phantom memory, which allows programmable memory and read-only memory overlay. CMC Marketing Corp has also developed a controller board for double-density floppy-disk drives and is marketing software application programs for businesses.

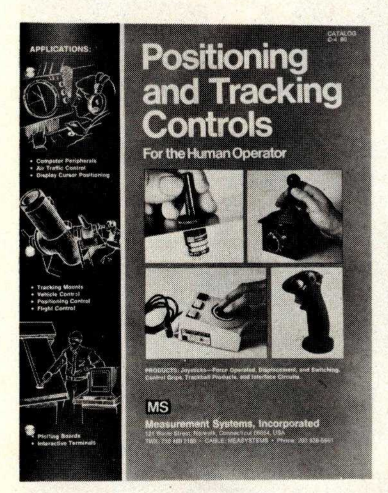
The price for the board is $1295. The price for the desktop mainframe $695.

Circle 516 on inquiry card.

What's New?

PUBLICATIONS

Positioning and Tracking Controls Catalog



Measurement Systems Inc, 121 Water St, Norwalk CT 06854, is publishing a sixteen-page catalog of positioning and tracking-control products. The controls in the catalog are used in computer peripherals, radar and other displays, and to position apparatus. The products include joysticks, trackballs, control grips, and interface electronic circuits. Contact the company for a copy of the catalog.

Circle 534 on inquiry card.

New Hardware Documentation from Ohio Scientific

Ohio Scientific (1333 S Chillicothe Rd, Aurora OH 44202) has introduced a line of paperback manuals documenting the boards used in OSI's computer systems. Each of the manuals, written by the Howard W Sams Company, contains schematics, labeled photographs with oscilloscope waveforms, integrated circuit pinout diagrams, parts lists including equivalent replacement parts by manufacturer, and other information. Two books are available now: the TM-100 *Servicing Data for Computer Boards 600 and 610, as used in Challenger Series Superboard II, Model C1P, and Model C1P-MF*, 36 pages, $7.95; and the TM-200 *Servicing Data for Computer Boards 502, 505, 527, 540, and 542, as used in Challenger Series Model C4P and C4P-MF*, 92 pages, $15.95. Both books are available from local Ohio Scientific dealers. Similar books for the remaining Ohio Scientific systems are being prepared.

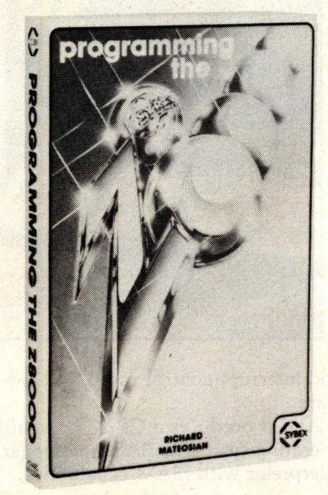
Circle 535 on inquiry card.

Software for the TRS-80

Software Innovations Co, 320 Melbourne Rd, Great Neck NY 11021, has a catalog of their software for the TRS-80. The free catalog includes games and other programs for the 16 K Model II or 32 K floppy-disk system.

Circle 536 on inquiry card.

Programming the Z8000



Programming the Z8000, by Richard Mateosian, has been released by Sybex, 2344 Sixth St, Berkeley CA 94710. This book presents a detailed description of the Z8000 and is valuable to those interested in learning machine-language programming. The book covers input/output (I/O) techniques, peripheral components, utility programming examples, addressing modes, hardware organization, and a complete instruction set. Information on the engineering and applications of the Z8000 and instructions on writing programs are included. The price is $15.95.

Circle 537 on inquiry card.

Computer and Data Processing Books

The Wiley Professional Books-By-Mail Division of John Wiley and Sons Inc, Somerset NJ 08873, has published a catalog of books dealing with computers and data processing. Some of the titles are *Computer Networks and Their Protocols, Writing Interactive Compilers and Interpreters, On the Design of Stable Systems*, and *An Introduction to General Systems Thinking*. For a copy of the catalog and more information, contact the company.

Circle 538 on inquiry card.

How To Start Your Own Systems House

How To Start Your Own Systems House is a guide that covers most aspects of starting and operating a small-business computer company. Market selection and evaluation, industry application opportunities, equipment selection, evaluation of vendors, becoming a dealer and distributor, building a sales force, effective advertising, shows, product pricing, and equipment service are some of the subjects discussed. The book contains samples of contracts, proposals, agreements, advertising letters, and a complete business plan. The book is priced at $36 and is available from Essex Publishing, 285 Bloomfield Ave, Caldwell NJ 07006.

Circle 539 on inquiry card.

TRS-80 Interfacing



TRS-80 Interfacing, by Dr Jonathan Titus, explains a number of interfacing techniques that can be used with the TRS-80 Breadboard, a product that allows custom interfacing of peripherals to the TRS-80 computer. Schematic diagrams, software listings, and eighteen experiments are included. The book will enable users to acquire the tools needed to design interfaces and to write the necessary software for the TRS-80. The book is priced at $8.95, plus $1 shipping and handling. For further information, contact Group Technology Ltd, POB 87, Check VA 24072.

Circle 540 on inquiry card.

Addressable PET Printer Adapter

The ADA 1400 adapter drives a printer with an RS-232 interface from the PET IEEE-488 bus. The ADA 1400 is addressable, works with the Commodore disk, and prints uppercase and lowercase American Standard Code for Information Interchange (ASCII) characters. The PET IEEE type port is provided for daisy-chaining other devices. A cassette tape is included with programs for plot routines, data formatting and screen dumps. The ADA 1400 sells for $179 and includes a PET IEEE cable, RS-232 cable, power supply, case, instructions, and software. Contact Connecticut microCOMPUTER Inc, 150 Pocono Rd, Brookfield CT 06804.

Circle 541 on inquiry card.

General Ledger System for TRS-80 Model II

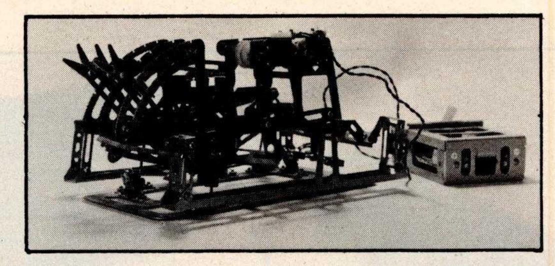
This general ledger system features unlimited inherent files, a year-to-year comparison on the income statement and the balance sheet, account transaction summary reports for up to a year, and automatic posting of retained earnings to user-defined accounts. The Cash Journal provides a cumulative listing of cash receipts and disbursements that result in permanent deposit records and cash register listings. Reports consist of trial balance, income statement, balance sheet, and special accounts report. Percentages to sales and prior year variances are also available. The price for the program is $249.95 and the package is available from Taranto and Associates, POB 6073, San Rafael CA 94903. Circle 542 on inquiry card.

Tiny Switcher

This 12.7 mm cube (0.5 inch) is an extremely small switching-mode power supply and the smallest of the μS family of switchers. The μS-A can operate from line voltages of 90 to 255 VAC at 47 thru 440 Hz, and it has 2500 V isolation from input to output. The AC input is transient-protected and DC voltages are protected from 1.5 to 15 VDC. Applications include powering low-power systems ranging from digital panel meters to smoke alarms, as well as charging nicad batteries. For more information, contact Microsource Corp, 7330 Rogers Ave, Chicago IL 60626. The original equipment manufacturers price is listed at $8.89 with a minimum factory order of $25 or cash/check with the order.

Circle 543 on inquiry card.

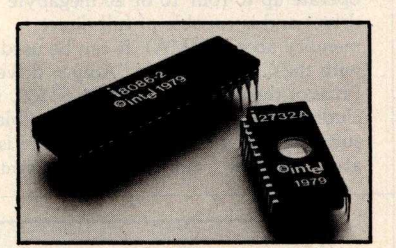
What Is It?



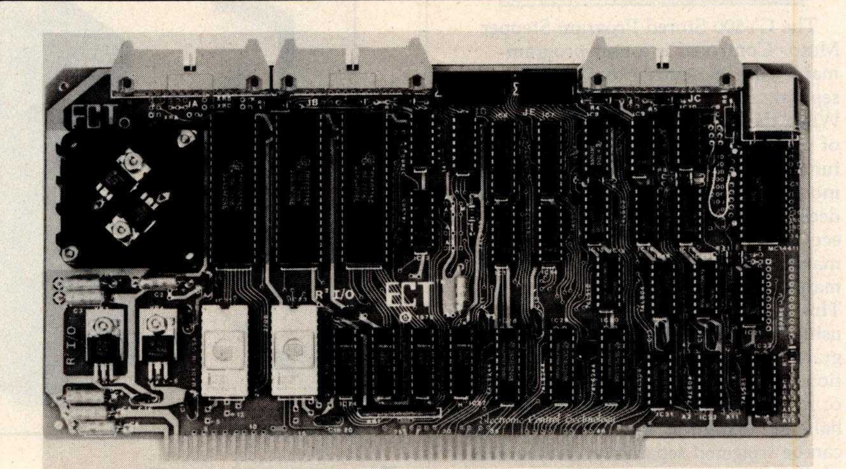
This unique item promises to be fun for the entire family. Designed for anyone between the ages of eight and eight and one-half, the unit comes replete with pieces of metal, wire, and a box for batteries. This specimen features a burned-out motor and two defunct batteries. Be the first to guess it — you win it. Send entries to Contest Editor, BYTE Publications, 70 Main St, Peterborough NH 03458.

Intel Develops the 8086-2 and the 2732A EPROM

Intel Corp, 3065 Bowers Ave, Santa Clara CA 95051, has announced the development of the 8086-2 microprocessor for the MCS-86 family of system components. The 8086-2 is a 16-bit, 8 MHz microprocessor that utilizes HMOS II technology. The 2732A 32 K bit erasable programmable read-only memory (EPROM) is a fourth-generation design based on HMOS-E technology. It operates at maximum access times down to 200 nanoseconds. Because of the speed of the 2732A, wait-states for program store memory references are not necessary using the 8086-2. Bipolar bus support, large-scale integration peripherals, and dynamic and static memory devices usable with the standard 5 MHz 8086 can also be used with the 8 MHz version. Additionally, the 8089 input/output processor can be used in 8086-2 systems, acting as a co-processor in the system, executing input/output programs concurrently with the 8086 execution of the main program. The 8086-2 is currently priced at $200 in quantities of 100 and the 2732A EPROM is currently priced at $570.



Circle 545 on inquiry card.



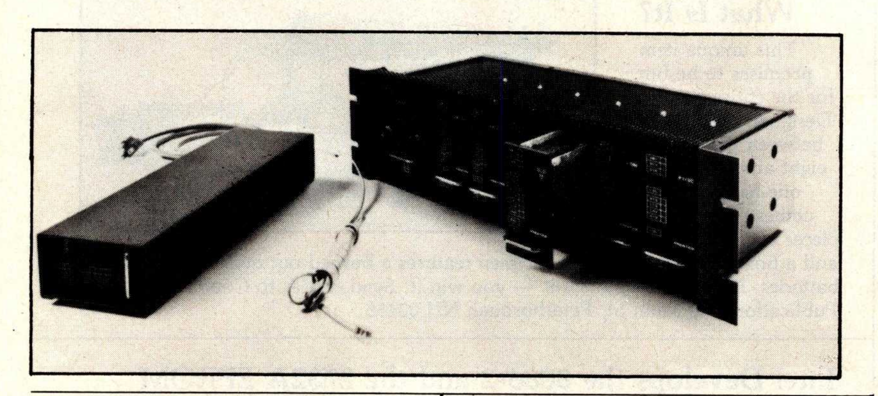
Memory and Input/Output Board

R²I/O is an S-100 bus input/output (I/O) board with three serial I/O ports, one parallel I/O port, four status ports, 2 K bytes of read-only memory (ROM), and 2 K bytes of programmable memory. The board can be used as an interfacing device and as a computer control from a terminal keyboard with a ROM monitor containing executive commands and I/O routines. Data rates are selectable in the range of 75 to 9600 bits per second and the voltage levels of the serial I/O ports are RS-232 compatible. The price for the board is $295. For information contact Electronic Control Technology, 763 Ramsey Ave, Hillside NJ 07205.

Circle 546 on inquiry card.

What's New?

MISCELLANEOUS



Bell-Compatible, Low-Speed Modems Feature Integral DAA

Prentice Corporation is offering a family of modems that allow transmission of 300 bits per second (bps) asynchronous data over the dial-up switched telephone network without an external data-access arrangement (DAA). The family consists of the P103J Originate/Auto Answer, P113C Originate, and P113D Auto Answer modems. The modems have a standard RS-232C digital interface and a line interface defined by FCC Part 68. The modems provide half- or full-duplex transmission and reception of serial binary asynchronous data over two-wire, dial-up telephone facilities. An integral DAA allows connection of the modems to the telephone network by means of a modular jack. They also feature indicators that monitor up to nine conditions and parameters. The P103J is priced at $470; the P113C is priced at $385, and the P113D at $395. For information contact Prentice Corp, 795 San Antonio Rd, Palo Alto CA 94303.

Circle 532 on inquiry card.

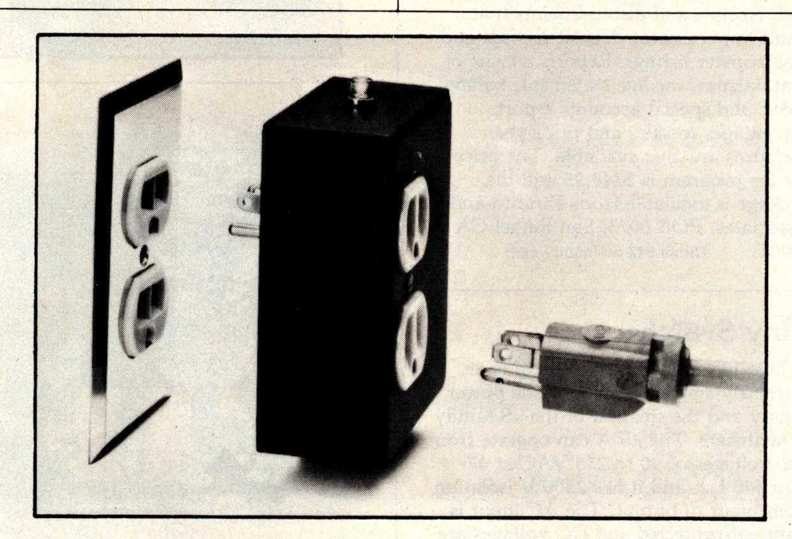
User-Programmable Integrated Circuit Controller for Stepper Motors



The CY500 Stored Program Stepper Motor Controller is a user-programmable NMOS device executing 22 separate function-oriented commands. When the CY500 is in the ASCII mode of operation, the instructions form a function-oriented language. In this mode, parameters are entered as ASCII decimal numbers. The CY500 can execute commands at once in the command mode, or store a sequence of commands and then run them as a program. This feature allows program looping using DO-WHILE instructions and program waits using WAIT-UNTIL instructions. Other instructions control single- or multi-step mode operation, full- or half-step operation, and more. Each step can be triggered separately, and control of direction, starting, and stopping may be done either via external hardware or via software control. Control of step rates up to 3500 steps per second is possible. Asynchronous communication with the CY500 may be achieved in serial or parallel fashion. The device uses a single +5 V power supply, and is priced at $95. For more information, contact Cybernetic Micro Systems, 445-203 S San Antonio Rd, Los Altos CA 94022. Circle 530 on inquiry card.

Disk-Drive Controller for the S-100 Bus

Cameo Data Systems Inc, 1626 Clementine St, Anaheim CA 92802, is shipping their DC-500S Cartridge Disk-Drive Controller for S-100 bus microcomputers. The controller will operate up to four 10 or 20 megabyte drives and is capable of full direct memory access (DMA). It can be used with the CDC Hawk and Ampex drives. Price of the controller alone is $1550, including cables and a CP/M-compatible software driver. Diagnostic software is also available. Circle 531 on inquiry card.



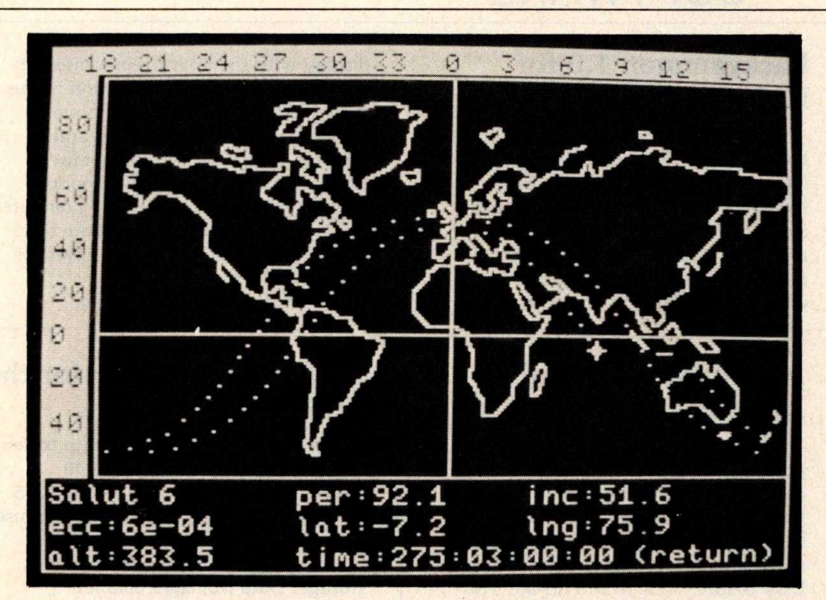
Protection from Power Surges

This power-surge-control device protects small computers as well as communications, medical and other electronic equipment from destructive voltage transients. The Surge Sentry 120 plugs into standard 120 VAC wall outlets to provide protection from transients. In operation, the SS-120 detects and quickly shunts short duration voltage surges. The device has a response time of less than 1 ns and a power dissipation capacity of 600,000 watts. A light-emitting diode lets the user know that the device is functioning properly. The unit is parallel with the power line so the SS-120 will not interrupt equipment operation if it malfunctions. The suggested price is $89.50 and it is available from R&K Enterprises, 643 S 6th St, San Jose CA 95112.

Circle 533 on inquiry card.

What's New?

SOFTWARE



Satellite Tracking Software

Sat Trak International produces satellite tracking software for beginners, professionals, or schools. The programs allow amateur radio operators to make azimuth, elevation, and range calculations for a one-week period in just a few minutes. Astronomers can compute the right ascension and declination of a synchronous satellite and quickly acquire it by telescope. All that is required for input are orbital parameters for each satellite, which are available from NASA at no cost.

FORTRAN and BASIC listing versions are $35. The full package on 5-inch disks for the TRS-80 and Apple II is $48.50. The cassette version costs $29.95. Contact Sat Trak International, c/o Computerland of Colorado Springs, 4543 Templeton Gap Rd, Colorado Springs CO 80909.

Circle 517 on inquiry card.

Inventory Control System for the TRS-80

INV-V is an inventory-control system for 32 K byte TRS-80 disk systems. It includes an order report which gives the inventory items at or below the safety levels along with associated order information, such as the order quantity, the vendor code, and the total amount in dollars. The system also indicates priority to order. The performance report measures the efficiency of the inventory system and the associated costs. Other reports include a data base lister and an end-of-year processor. A report writer allows users to specify unlimited report formats on line without any programming. Other features include form input, live keyboard, audit log, automatic page numbering, and simulated form feed. The package is priced at $99, including a program disk, a data disk, and a manual. For information, contact Micro Architect, 96 Dothan St, Arlington MA 02174.

Circle 518 on inquiry card.

Depreciation System for Small Businesses

The Depreciation System is a package of BASIC programs written for the North Star disk system that provide depreciation preparation aids for accounting services. The system allows users to create files of assets of past and future depreciation amounts. Standard methods of straight line, declining balance and sum of year-digits, and nonstandard depreciation methods can be used with the system. Some of the programs included are MDBLD, used to establish client files; MDADD, used to create new asset records; MDUPDT, used to modify existing asset records; MDDMP, for producing formatted listing of asset files; and MDSTAT, which is used to produce yearly summaries of depreciation. An average of 1300 assets can be stored on a double-density floppy disk.

The system is available from Business Computer Systems, 900 Roanoke Dr, Springfield IL 62702, for $100. The price includes a manual and program documentation.

Circle 519 on inquiry card.

Machine Language Utility Pac

The Machine Language Utility Pac is designed for the PET microcomputer. The package includes an extended monitor, a disassembler, hexadecimal-to-decimal conversion, screen dump onto a printer, a machine-code relocate, and a tape relocate, all written in machine code. Two extra programs, Renumber and Merge, are used with BASIC programs.

The package comes with a combination of a BASIC and a machine code program designed to relocate the utility pac to any amount of memory. It is priced at $29.95 from P S Software House, POB 966, Mishawaka IN 46544.

Circle 520 on inquiry card.

PSYCH-UP for SwTPC 6800 Systems

PSYCH-UP is a program that permits Flex 9.0 software to be run on SwTPC 6800 systems that have been upgraded with a Percom adapter module and PSYMON monitor for 6809 operation. PSYCH-UP resolves all Flex incompatibilities without hardware modifications. The software modification is accomplished using a two-drive SwTPC MF-68 floppy-disk system. Unmodified versions of both Flex 2.0 and Flex 9.0 are required. These are available from Technical Systems Consultants Company (TSC) or a TSC dealer. The program comes on a 5¼-inch floppy disk with instructions for $29.95. Contact Percom Data Co, 211 N Kirby, Garland TX 75042. Circle 521 on inquiry card.

What's New?

SOFTWARE

Verify Saved Programs on Apple Tape Systems

The Applesoft Tape Verifier will provide either an Apple II or an Apple II Plus computer with the ability to verify programs saved to cassette. The program remains resident in the computer as long as power is applied and the computer is in the Applesoft mode. The program costs $20 and is supplied on an Apple-compatible cassette. Contact Softsell Associates, 2022 79th St, Brooklyn NY 11214.

Circle 522 on inquiry card.

Machine Language Sorts for the TRS-80 Model II

A Generalized Subroutine Facility (GSF) is available for the TRS-80 Model II computer. Machine language functions in BASIC through USR calls include multi-key, multivariable in-memory sort; multi-key character string in-memory sort; USR peek and poke capability, both byte and word, fetch argument; compress and uncompress data; move blocks of data; and propagate across arrays. The system can sort 1000 elements in six seconds and can carry up to fifteen arrays together with multiple mixed ascending and descending keys. Sorts on multiple columns in character string sort mode can be done. The GSF is available from Racet computes, 702 Palmdale, Orange CA 92665, for $50 on a disk-operating system floppy disk.

Circle 523 on inquiry card.

Screen Editor for SS-50 Bus

Alford and Associates has developed a screen editing system, the SCREDITOR, for operation with Smoke Signal Broadcasting disk-operating system version 5.1X. The SCREDITOR provides fourteen edit commands and, in the screen editing mode, twenty-two screen operators are included. Dual-mode operation is provided, allowing the editing of source- and text-typed material whose lines must be exactly defined. The SCREDITOR operates with 16 by 64 or 24 by 80 character memory-mapped displays for the SS-50 bus. A manual is provided that explains how to modify the package. Keyboard definition, system input and output, and other aspects are user-alterable to meet special requirements. The system is priced at $99.95 and is available from Alford and Associates, POB 6743, Richmond VA 23230.

Circle 524 on inquiry card.

Backgammon 1.0 for North Star BASIC 3.6

GIGA, POB 1881, Chicago IL 60690, has released a Backgammon 1.0 for North Star users on disk for $15 or in a listing for $10. A player can compete against the computer at two levels, or against another player, or allow the computer to play itself. Output fits within a scrolling, 16 by 64 character display with the board represented at the left and playing information at the right. Features include legal move evaluation, end game scoring and optional display of computer move evaluations. Various playing options may be changed during play. Computer or player can double or generate dice rolls. Board positions can be saved or created for replay.

Circle 525 on inquiry card.

Advanced Statistical Analysis for the TRS-80

Radio Shack has available a series of programs designed for the analysis of data in business, education, medicine, government administration and other fields. Advanced Statistical Analysis may be used with Level II BASIC or Disk BASIC on a 16 K TRS-80. The system consists of a manual and 13 programs on cassette. Some of the programs supplied with the system are Tape Data Files, Disk Data Files, Random Sample, Descriptive Statistics, Histogram, Frequency Distribution, and Analysis of Variance. The package is sold at Radio Shack Computer Centers and other Radio Shack stores and dealers for $39.95. For more information, contact Radio Shack Computer Customer Services, 205 NW 7th St, Fort Worth TX 76106.

Circle 526 on inquiry card.

Data Base Manager for the TRS-80

The Data Manager accepts up to ten user-defined fields with up to 40 characters per field and a total of 255 characters per record. The program uses up to four disk drives on line, for as many as 320 K bytes of storage. Data Manager enables the user to create up to five "key" sort files for quick access of data. A utility program is provided to calculate the number of records possible. The program also supports the uppercase and lowercase modification, and printouts can be programmed to most formats and sent to line or serial printers. Background printing is provided for Centronics printers. The Data Base Manager is available from The Bottom Shelf Inc, POB 49104, Atlanta GA 30359. It is priced at $49.50.

Circle 527 on inquiry card.

Software Package for Pascal Programmable Graphics Computer System

Ramtek Corp, 2211 Lawson Ln, Santa Clara CA 95050, has introduced a graphics software package written in UCSD Pascal. Called GRAPHPRO, the package consists of a set of routines and procedures designed to facilitate programming on Ramtek's RM-6114 and RM-6113 graphics computer systems. Routines available include text with programmable font, rotating in 90-degree increments; windowing and clipping; scaling and translation; viewport capability; filled polygons in solid colors, programmable patterns, five standard marker symbols, with others programmable by the user; arcs and circles; and object overlay. Typical applications include business charts, process control, plotting, forecasting and modeling, and statistical analysis. The package is priced at $1750 for a one-time license fee.

Circle 528 on inquiry card.

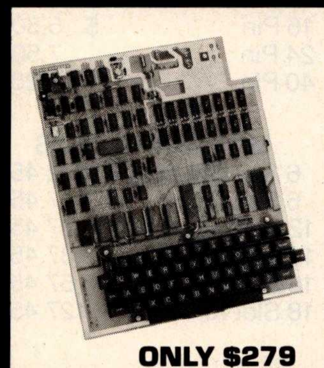
The Postmaster Mailing List System

Lifeboat Associates, 2248 Broadway, New York NY 10024, is offering The Postmaster, a mailing-list management system. The Postmaster includes a batch entry facility and an optional reference field that allows users to segment the list by code and extract records based on any field. The system provides the option on an automatic "ID" field insertion. By keying in a name, a ten-character record identifier will be entered automatically to the reference field. This provides a reference number for each mail list record. Other features include a program to prepare and edit form letters and to record-sort based on any specified field using the Shell-Metzner sorting algorithm.

The program runs in over twenty different disk formats with CBASIC on all 8080 and Z80 computers using CP/M. The price of the system is $150. The manual alone is $15.

Circle 529 on inquiry card.

Now get OHIO SCIENTIFIC personal computer products with guaranteed, quick, mail order delivery.



ONLY $279

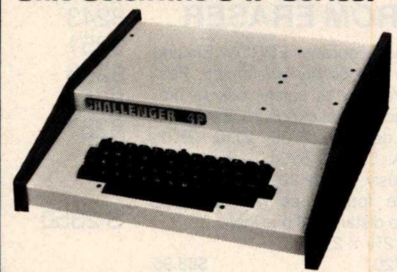
Ohio Scientific Superboard II

The first complete computer system on a board. Includes keyboard, video display and audio cassette interface. 8K BASIC-in-ROM; 4K RAM. Requires power supply +5V at 3 Amp.

"We heartily recommend Superboard II for the beginner who wants to get into microcomputers with a minimum cost. A real computer with full expandability."
POPULAR ELECTRONICS, MARCH, 1979

"The Superboard II is an excellent choice for the personal computer enthusiast on a budget."
BYTE, MAY, 1979

Ohio Scientific C4P Series.



The Challenger 4P. A 4-slot computer with one open slot. Highly sophisticated 16 color video display. 32 rows x 64 columns, upper and lower case. 8K BASIC-in-ROM 8K RAM. 200-20KHz programmable tone generator. AC remote interface. Expandable to 32K RAM and two mini-floppy drives. **$698.**

The Challenger 4P MF. Mini Floppy version of the 4P. Two to three times faster than competitors. More I/O built-in than any other in its class. 24K RAM. Real time clock. Modem interface. Printer interface. Foreground/Background operation and much, much more. **$1695.**

Ohio Scientific C1P Series.



The Challenger 1P. The best bargain in personal computer anywhere! 8K BASIC-in-ROM. 4K RAM. Cassette based with 53-key keyboard. B&W video display, 30 rows x 30 columns. Upper and lower case. **$349.** C1P with 8K RAM $399.

Ohio Scientific C1P MF. Mini-floppy version of the C1P. 8K BASIC-in-ROM, 12K RAM. Fully expandable. **$995.** C1P MF with 20K RAM and OS-65D software $1198.

Accessories

AC-3P 12" B/W monitor, TV	**$ 125**
AC-15P 12" Color monitor	**$ 450**
AC-16P 2-8 Axis Joysticks with cable	**$ 39**
AC-11P Answer/Originate 300 baud modem with cable	**$ 199**
AC-17P Home Security Starter Set. 1 fire detector, 2 window alarms, 1 door unit.	**$ 249**
AC-18P 8½" aluminized paper printer. Upper/lower case.	**$ 695**
AC-9TP Centronics 799 110cps tractor feed, business printer with interface	**$ 1250**
AC-12P AC-Remote starter set. Console. 2 lamp modules, 2 appliance modules, OS 65D home control operating system	**$ 175**
Disk Drives	
CD 3P Single 5" mini floppy	**$ 499**
CD 2P Dual 8" Disk with interface and OS-65D DOS	**$ 1599**
Power Supplies	
PS 1. 5-volt @ 3 amps regulated. For use with Superboard II	**$ 29**
Boards (Assembled and tested)	
CM 9P. 24K Static.	**$ 399**
610. 8K Static. Expandable to 24K and dual mini-floppy controller.	**$ 298**
CA-14A. Votrax® voice synthesizer.	**$ 399**
CA-15 Universal Telephone Interface, rotary or touch tone	**$ 499**
CA-15V UTI with Votrax®	**$ 799**
CM-6 48K Dynamic memory board.	**$ 499**
4KP. 4K static RAM kit	**$ 69**
CA12. 96 line parallel I/O	**$ 175**
Books:	
How to Program Microcomputers, By William Barden	**$ 8.95**
Basic and Personal Computer By Dwyer & Critchfield	**$12.95**
Howard Sams C1P Service Manual	**$ 7.95**
Howard Sams C4P Service Manual	**$15.95**

Ohio Scientific 8P Series.



Challenger 8P. Ohio Scientific's mainframe-class. Personal computer. 8 slots with 6 open. Cassette based with 8K BASIC-in-ROM. 8K static RAM, expandable to 32K RAM, and dual 8-inch floppy disk drive. **$895.**

Challenger 8P DF. A top of the line personal and small business computer. 32K RAM, expandable to 48K. Features dual 8" floppy disk drives. Audio output 200 20KHz. DAC for voice generation. Keypad interfaces. Joystick (2) interfaces. AC Remote. Real Time Clock. Printer & Modem interfaces. And more. **$2597.**

SOFTWARE

Cassettes

Add Game	**$ 6.00**
BASIC Tutor Series	**$29.00**
Function Grapher	**$ 6.00**
Address Book	**$ 8.00**
Programmable Calculator	**$12.00**
Savings Account	**$ 6.00**
Baseball I	**$ 6.00**
Battleship	**$ 6.00**
Bowling	**$ 6.00**
Destroyer	**$ 6.00**
Space War	**$ 6.00**
Star Trek	**$ 6.00**
Tiger Tank	**$12.00**

Disks

MDMS Education System	**$29.00**
MDMS Aux File Systems	**$29.00**
MDMS Checking and Savings Account	**$29.00**
MDMS Personal Calendar/Address Book	**$29.00**
Home Control II	**$29.00**
DAC I Music Generation	**$39.00**
Baseball I & II, Golf, Bowling, Hockey	**$39.00**
Poker, Black Jack, Spades, Hearts, more	**$29.00**
Tiger Tank, Space Attack, Etch-A-Sketch, more	**$29.00**
Star Wars, Zulu 9, High Noon, more	**$29.00**
Monster, Kite, Three Little Pigs, Humpty Dumpty and more (2 Disk Set)	**$29.00**

When ordering, specify Challenger 1P, 4P or 8P

Many, many more software systems are available to you. See our catalog for complete listings.

Freight Policies

All orders of $100 or more are shipped freight prepaid. Orders of less than $100 please add $4.00 to cover shipping costs. Ohio Residents add 5.5% Sales Tax.

Guaranteed Shipment Cleveland Consumer Computers & Components guarantees shipment of computer systems within 48 hours upon receipt of your order. **Our failure to ship within 48 hours entitles you to $35 of software, FREE.**

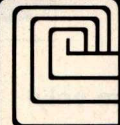
To Order:

Or to get our free catalog
CALL 1-800-321-5805 TOLL FREE.
Charge your order to your **VISA** or **MASTER CHARGE** ACCOUNT
Ohio Residents Call: (216) 464-8047.
Or write, including your check or money order, to the address listed below.





Hours:
Call Monday thru Friday
8:00 AM to 5:00 PM E.S.T.



CLEVELAND CONSUMER COMPUTERS & COMPONENTS
P.O. Box 46627
Cleveland, Ohio 44146

TO ORDER: CALL
1-800-321-5805
TOLL FREE

Circle 199 on inquiry card.

DAL-COMP MAIL ORDER DIV.

EPROM ERASER

Compact, durable EPROM Erasing Lamp with quality UV source. Features a special safety lock to prevent accidental exposure. Erases up to 4 devices (2708, 2716, 2732, 1702A, 5203Q, 5204Q, etc.) simultaneously within 20 minutes. Conductive foam lines maintains exposure distance of one inch. 7⅝ × 2⅞ × 2.

UV-4/20 **$68.95**

MICROPROCESSORS

Z80A	$ 13.95
6502	11.95
8035	19.95
8080A	7.95
TMS 9900	29.95

8080 SUPPORT

8212	$ 2.50
8214	4.50
8216	2.50
8224	3.25
8228	5.95
8238	6.25
8243	7.95
8251	6.95
8253	19.50
8255	5.95
8257	17.95

USRT

S 2350	$ 7.95

UARTS

TR 1602 B	$ 3.95
TR 1863	5.95

DISC CONTROLLER

1771	$ 26.95
1791	37.95

PROMS

1702	$ 4.95
2708	7.95
2716 — 5-Volt	21.95
2758	27.95

DYNAMIC RAMS

4116-250ns	8 for $ 59.95
2104/4096	3.95
4027-4-250ns	3.95

STATIC RAMS

21L02 (450)	$ 1.25
21L02 (250)	1.50
2114L (450)	4.99
2114L (300)	5.20
4044/5257 (450)	7.50
4044/5257 (300)	9.25

CRYSTALS

4 MHZ	$ 3.95
14.318 MHZ	3.95

DIP SWITCHES

3 Pos.	$1.00	6 Pos.	$1.10
4 Pos.	1.00	7 Pos.	1.15
5 Pos.	1.00	8 Pos.	1.20

ZIP DIP II SOCKETS

16 Pin	$ 5.50
24 Pin	7.50
40 Pin	10.25

MOTHER BOARDS

6 Slot Bare Board	$22.45
6 Slot Kit	47.45
12 Slot Bare Board	37.45
12 Slot Kit	87.45
18 Slot Bare Board	57.45
18 Slot Kit	127.45

RS 232 — CONNECTORS

DB25P — Male Plug	$ 2.95
DB25S — Female Socket	3.60
DB25C — Cover	1.50

100% 90 DAY MONEY BACK GUARANTEE ON ALL ITEMS SOLD
SEND $2.00 for 1980 CATALOG

DAL-COMP MAIL ORDER DIV.

TERMS OF SALE: Cash, checks, money orders, VISA, Master Charge. Minimum order $10.00. Texas residents add 5% sales tax. Minimum shipping and handling charge $2.50. COD orders add $1.15 COD fee. U.S. funds only. D&B rated firms call for open account. Universities and computer clubs call for discounts.

DAL-COMP M/O DIV. 2560 ELECTRONIC LANE, SUITE 108, DALLAS, TEX. 75220 • (214) 350-6895

Circle 200 on inquiry card.

UP TO 25% OFF

YOUR OWN TRS-80 SYSTEM AT TREMENDOUS SAVINGS

Visit our new Store at 20th & Walnut, Phila., PA



ITEM	REG. PRICE	OUR PRICE
Level II—4k	**$619.00**	**$575.70**
Level II—16k	**$849.00**	**$789.60**
Expansion Interface	**$299.00**	**$278.00**
Mini Disk Drive	$ 495.00	$ 385.00
Centronics 779 Printer	$1599.00	$1175.00
Centronics 101 Printer	$1595.00	$1400.00
Anadex DP-8000 Printer	$1295.00	$ 995.00
Memory Kit (16K) FREE INSTALLATION	$ 149.00	$ 98.00
Verbatim Diskettes ea.	$ 5.95	$ 4.95
3	$ 17.89	$ 12.00
10	$ 59.00	$ 37.00
C-10 Cassettes 5	$ 4.95	$ 4.50
25	$ 24.75	$ 18.75
Paper (9½" x 11" fanfold, 3500 sheets)	$ 35.00	$ 29.95

NOW OPEN
VR DATA'S Computer Repair Center

TRS—80 MODEL II **$3626.00**
- 64K RAM
- ½ MEG DISK

VR Data's 1st Drive **$899.00**

ADDITIONAL DISK DRIVE (1ST) $1069.50
ADDITIONAL DISK DRIVE (2ND + 3RD) $ 558.00

BUSINESS SOFTWARE

	Model II	Model I
Payroll	$199.00	$99.00
General LEDGER (inc. AP, AR, etc.)	$199.00	$149.00
DATA BASE MANAGEMENT SYSTEM	$249.00	$149.00

Documentation only (each Package) $5.00

GENERAL SOFTWARE

NEW DOS+	35 tk. $99.00	40 tk. $110.00
Electric Pencil	Tape $99.00	Disk $150.00
Upper/Lower Case Conversion	Tape $19.95	Disk $24.95
Diagnostics	Tape/Disk $34.55	
Household Inventory		Disk $19.95
Loan Amortization Schedule		$19.95

APRIL SPECIAL

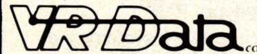
Good Until 4/30/80

Centronics 730 *$695.00*
Centronics 737 *$950.00*

NEW SOFTWARE

TPM - Model I & II
CPM Compatible
Z80 Operating System
10 Meg Removable Disk for Mod II
Send for **free** catalog

There are new developments every day— write or call for the latest information.



777 Henderson Boulevard N-6
Folcroft Industrial Park
Folcroft PA 19032
(215) 461-5300



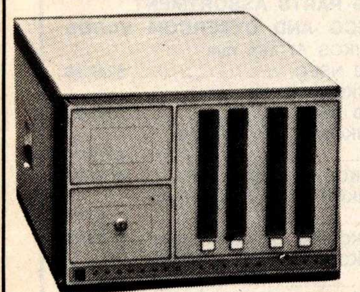
TOLL FREE
1-(800) 345-8102 *Orders only!

FOREIGN and DOMESTIC DISTRIBUTORSHIPS AVAILABLE . . .

Circle 201 on inquiry card.

MICRO BUSINESS WORLD™ MAIL ORDER

Immediate response to your orders (verbal or written). Phone (213) **371-1660**



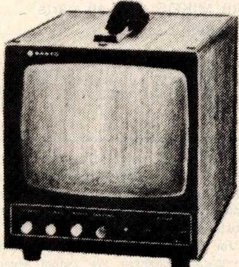
Cromemco **System Three** *FEATURES . . .*
- Z-80A Micro Processor • 64K RAM
- Dual 8" Double Sided Disk Drive easily expandable to 4 Drives • RS232 and Printer Interface.

CALL FOR **OUR PRICE**

Cromemco **System Two** *FEATURES . . .*
- Z-80A Micro Processor • 64K RAM
- Wangco Drives • RS232 and Printer Interface.

CALL FOR **OUR PRICE**

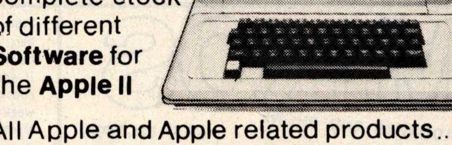
SANYO *9" MONITOR*



A Superb Black and White TV Monitor that can be used with most Computers

OUR PRICE $185

Apple II personal computer.



We have a complete stock of different **Software** for the **Apple II**

All Apple and Apple related products...
20-25% OFF list price

ATARI 800 Personal Computer System

Packed with: Computer Console, Basic Language Card, Education System Master Cartridge, Cassette Recorder, TV Modulator, 8K Memory (expandable to 48K), Power Supply & all Books and Manuals **$849.99**

ATARI 400 Personal Computer System for less

Packed with: Computer Console, Basic Language Cartridge, Power Supply, TV Modulator, and all Books and Manuals **$524.99**

ATARI Program Recorder		**69.99**
ATARI Software, Roms, Cassettes		25% off list price
ATARI Expansion Memory	8K Module	**99.99**
	16K Module	**169.99**

Texas Instruments **TI-99/4** Home Computer



The TI-99/4 gives you an unmatched combination of features, including: • Powerful TI-BASIC–built-in 13-digit, floating point BASIC. • Up to 72K total memory capacity —16K RAM (Random Access Memory), 26K ROM (Read Only Memory), plus up to 30K ROM in TI's Solid State Command Modules. • 13" color monitor included. • Revolutionary Solid State Speech™ Synthesizer (optional) **Our Price $999.**

The Vector MZ Microcomputer

System B is a Z-80 based microcomputer with over 630,000 characters of on-line storage and is capable of handling standard accounting or special computations of any small business or large company department — even scientific calculations in a technical environment.
Call for **Our Price**

ZENITH DATA SYSTEMS:
Smart Video Terminal



Z-89 Computer System:
includes: Z19 Display, a built in 5¼" Floppy Disk, 2 serial ports, and 16K of memory. **2295.00**
48K Memory version **2595.00**

Z-19 has a Z80 Microprocessor, Numeric Keypad and 8 function key **$895.00**



IDS 440 Impact Printer
The Paper Tiger
This low-cost printer has the capability of printers twice it's price. *Ideal for use with small computers*
w/graphics **OUR PRICE $1050.**

DYSAN DISKETTES *THE CADILLAC OF THE FLOPPY DISKS AT LOW LOW PRICES*

8" (Box of 10) 3740/1 sgl side/sgl density	$4.00 ea.
5" (Box of 5) 3740/1D sgl side/dbl density	$6.50 ea.
104/1 Soft sector or 107/1 10 Sectors or 105/1 16 Sectors	$4.00 ea.

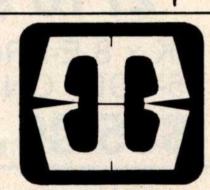
For each 2 boxes of 8" or 4 boxes of 5", you get one plastic storage case — but hurry supply is limited.

Plastic Floppy Disk Holder (up to 10) 8" **$3.95**
Plastic Floppy Disk Holder (up to 10) 5" **$3.25**

16K RAM set of 8 4116's 250 ns or better **$65.00**

Prices subject to change without notice.
VISA and MASTER CHARGE WELCOME. Allow 2 weeks for cashiers check to clear, 4 weeks for personal checks. Add 2% for shipping and handling. Calif. residents add 6% sales tax. (Sorry, no C.O.D.)

U.S. and International dealer inquiries invited.



MICRO BUSINESS WORLD™
15818 Hawthorne Boulevard
Lawndale, California 90260 (213) **371-1660**

 Circle 202 on inquiry card.

Circle 203 on inquiry card.

CALIFORNIA COMPUTER SYSTEMS

16K RAM BOARD. Fully buffered addressable in 4K blocks. IEEE standard for bank addressing 2114's. PCBD ....$ 26.95 Kit 450 NSEC $249.95

PT-1 PROTO BOARD. Over 2,600 holes 4" regulators. All S-100 buss functions labeled, gold fingers. PCBD $25.95

PT-2 PROTO BOARD. Similar to PT-1 except set-up to handle solder tail sockets. PCBD $25.95

CCS MAIN FRAME. Kit (S-100) $349.95

APPLE EXTENDER. Kit ....$ 22.95

APPLE IEEE INSTRUMENTATION INTERFACE KIT 7490. Kit $275.00

ARITHMETIC PROCESSOR FOR APPLE 7811A. Kit $350.00

APPLE ASYNCHRONOUS SERIAL INTERFACE 7710A. Kit $89.95

APPLE SYNCHRONOUS SERIAL INTERFACE 7712A. Kit $89.95

ALL OTHER CCS PRODUCTS AVAILABLE

SSM

PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies require textool sockets. Kit $129.95

CB-1A 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status. Kit ....$129.95 PCBD $30.95

VB-3 80 x 55 VIDEO BOARD. Graphic included .... TBD

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports. Kit ....$130.00 PCBD $26.95

VB-1B 64 x 16 video board, upper lower case Greek composite and parallel video with software, S-100. Kit ....$125.00 PCBD $26.95

CB-2 Z80 CPU BOARD. Kit $185.95

AIO APPLE SERIAL/PARALLEL $159.95

ALL OTHER SSM PRODUCTS AVAILABLE

wmc inc. **WAMECO INC.**

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remic 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM™ (not included). PCBD $42.95

FPB-1 Front Panel. IMSAI size, hex displays. Byte, or instruction single step. PCBD $47.50

MEM-1A 8K x 8 fully buffered, S-100, uses 2102 type rams. PCBD $25.95

QM-12 MOTHER BOARD, 13 slot, terminated, S-100 board only $34.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt. PCBD $26.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD........$23.95

EPM-1 1702A 4K Eprom card. PCBD $25.95

EPM-2 2708/2716 16K/32K EPROM CARD. PCBD $25.95

QM-9 MOTHER BOARD. Short Version of QM-12. 9 Slots. PCBD $30.95

MEM-2 16K x 8 Fully Buffered 2114 Board PCBD $26.95

PTB-1 POWER SUPPLY AND TERMINATOR BOARD PCBD $25.95

IOB-1 SERIAL AND PARALLEL INTERFACE. 2 parallel, one serial and cassette. PCBD $26.95

2708 ....$9.49 2114 (200 NS) low pwr. 2114 (450 NS) low pwr. 5.99 ....$6.99

APRIL SPECIAL SALE ON PREPAID ORDERS
(Charge cards not included on this offer)

IO-4 LAYOUT REJECTS. One simple change. PCBD $20.00

8K x 8 RAM. Fully buffered. 450 NSEC assembled and tested. $99.99

MIKOS PARTS ASSORTMENT WITH WAMECO AND CYBERCOM PCBDS

MEM-2 with MIKOS #7 16K ram with L2114 450 NSEC $249.95

MEM-2 with MIKOS #13 16K ram with L2114 250 NSEC $279.95

MEM-1 with MIKOS #1 450 NSEC 8K RAM $119.95

CPU-1 with MIKOS #2 8080A CPU ....$ 94.95

QM-12 with MIKOS #4 13 slot mother board ....$ 89.95

RTC-1 with MIKOS #5 real time clock........$ 54.95

EMP-1 with MIKOS #10 4K 1702 less EPROMS ....$ 49.95

EPM-2 with MIKOS #11 16-32K EPROMS less EPROMS ....$ 59.95

QM-9 with MIKOS #12 9 slot mother board ....$ 79.95

FPB-1 with MIKOS #14 all parts for front panel $134.95

MIKOS PARTS ASSORTMENTS ARE ALL FACTORY MARKED PARTS. KITS INCLUDE ALL PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED. ALL SOCKETS INCLUDED.

MIKOS

NOTE: NEW ADDRESS AND PHONE (415) 726-7593
P. O. Box 955 • El Granada, CA 94018
Please send for IC, Xistor and Computer parts list

VISA or MASTERCHARGE. Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week delay for checks to clear. Calif. residents add 6% tax. Money back 30-day guarantee. We cannot accept returned IC's that have been soldered to. Prices subject to change without notice. **$10 minimum order. $1.50 service charge on orders less than $10.00.**



11542-1 KNOTT ST.
GARDEN GROVE, CA 92641
(800) 854-6411
(714) 891-2663

CERAMIC CAPS
.1 @ 12 VOLT
10¢ each
or
100/$9.00

MICROBYTE 16K RAM BOARD
- S-100 COMPATIBLE
- 4K BANK ADDRESSABLE
- EXTENDED MEMORY MANAGEMENT
- NO DMA RESTRICTIONS
- ASSEMBLED & TESTED
- RUNS AT 4 MHZ

$265.00

MICROBYTE 32K RAM BOARD
- S-100 COMPATIBLE
- BANK ADDRESSABLE
- EXTENDED MEMORY MANAGEMENT
- 8-BIT OUTPUT PORT
- ASSEMBLED & TESTED
- RUNS AT 4 MHZ

$540.00

LOBO

APPLE II
DISK DRIVE & INTERFACE
(1) SHUGART SA400, WITH CABLE **$395.00**
*WITH OPTIONAL INTERFACE CARD **$495.00**

LO-PRO SOCKETS

	1-24	25-99	100-up
14 PIN	.14	.13	.12
16 PIN	.15	.14	.12
18 PIN	.19	.17	.15
20 PIN	.26	.24	.23
24 PIN	.33	.31	.30
28 PIN	.37	.35	.30
40 PIN	.45	.42	.39

(ALL SOCKETS ARE TIN)

LOBO

SA800 DISK DRIVE
INSTALLED IN DUAL CABINET W/PWR SUPPLY
(1) DRIVE INSTALLED **$ 750.00**
(2) DRIVES INSTALLED **$1250.00**

2716's
2K x 8 E-PROM
5-VOLT ONLY
$35.00 each

IMSAI CONNECTORS
100 PIN—SOLDERTAIL
$2.75 each
or
10/$2.60. each

4116's
(250NS)
ADD-ON MEMORY FOR APPLE, TRS-80 HEATH, ETC.
8 for $70.00
or
16 for $130.00

2708's
1K x 8
450 NANO SEC.
E-PROM
$8.50 each
or
8/$60.00

74L $244
OCTAL BUFFER
$1.75 each

8251
U-ART
$5.00 each

REGULATORS

320 T-5	.90
320 T-12	.80
340 T-5	.75
340 T-12	.65
78H05	5.00
78L12	.30

APPLE SOFTWARE BY S.T.C.

MAILING LIST W/MANUAL **$34.99**
MAILING LIST W/PHONE OPTION ... **$40.00**
INFO-DATA BASE MANAGER PROG. ... **$100.00**
INVENTORY PROG. W/MANUAL **$140.00**
CALL FOR MORE DETAILS

ORDERING INFO
NAME, ADDRESS, PHONE
SHIP BY: UPS OR MAIL
SHIPPING CHRG: ADD $1.75 UP TO (5) LBS.

TERMS
WE ACCEPT CASH, CHECK MONEY ORDERS, VISA & MASTER CHRG. (U.S. FUNDS ONLY)
TAX: 6% CALIF. RES.

Circle 204 on inquiry card.

INTEGRATED CIRCUITS MICROPROCESSOR LED'S SOCKETS CAPACITORS DIODES POTENTIOMETERS

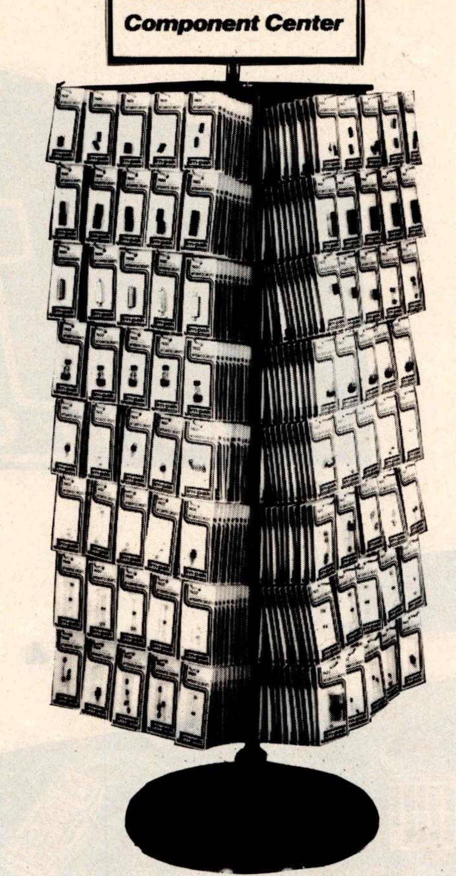
SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES SWITCHES CRYSTALS CONNECTORS HEAT SINKS

SWITCHES CRYSTALS CONNECTORS HEAT SINKS FUSEHOLDERS TEST CLIPS BOOKS KITS DIP JUMPERS CABLE ASSEMBLIES SWITCHES CRYSTALS CONNECTORS HEAT SINKS

Jim-pak®

electronic components

Now . . . better than ever. Over 320 items in stock. A more complete line of components and kits cannot be found anywhere! Everything needed for the amateur electronics buff to the advanced engineer. Reliable components for repair or construction. A variety of kits designed for easy assembly, yet rugged enough for everyday applications. Stop by your local distributor and check out the JIM-PAK line today!



one-stop component center

— TTL —

7400, 7402, 7404, 7408, 7410, 7420, 7430, 7432, 7442, 7447, 7473, 7474, 7475, 7476, 7485, 7490, 7492, 7493, 74107, 74121, 74122, 74123, 74125, 74154, 74161, 74176, 74177, 74192, 74193, 74367

— TTL —
Low Power Schottky

74LS00, 74LS02, 74LS04, 74LS08, 74LS10, 74LS20, 74LS30, 74LS32, 74LS42, 74LS47, 74LS73, 74LS74, 74LS75, 74LS83, 74LS85, 74LS86, 74LS90, 74LS109, 74LS123, 74LS136, 74LS138, 74LS151, 74LS157, 74LS175, 74LS192, 74LS193, 74LS367, 74LS368

— CMOS —

CD4000, CD4001, CD4010, CD4011, CD4013, CD4029, CD4044, CD4046, CD4049, CD4050

— CMOS Cont'd. —

CD4016, CD4017, CD4020, CD4023, CD4024, CD4051, CD4069, CD4071, CD4081, CD4511

— LINEAR —

LM301V . . . .
LM307V . . . .
LM309KC . . . .
LM311V . . . .
LM320K-5 . . . .(7905)
LM320T-5 . . . .(7905)
LM320T-12 . . .(7912)
LM320T-15 . . .(7915)
LM323K . . . .
LM324N . . . .
LM339N . . . .
LM340T-5 . . . .(7805)
LM340T-12 . . .(7812)
LM340T-15 . . .(7815)
LM380N . . . .
LM555V . . . .
LM556N . . . .
LM566CN . . . .
LM567. . . . .
LM723N . . . .
LM739N . . . .
LM741V . . . .
LM747N . . . .
LM1458V . . . .
LM1488N . . . .
LM1489N . . . .

— LINEAR Cont'd —

LM1556V . . . .
XR2206 . . . .
CA3080 . . . .
CA3130 . . . .
CA3140 . . . .
LM3900N . . (CA3401)
76477. . . . .

— MICRO-PROCESSOR —

Z-80, Z80A, 8080A, 8212, 8216, 8224, 8228, 6800, 6810, 6830L8, 2114-3, 2101, 2102, 21L02, 7489, MM5262, 1702A, 82S23, 2708, 8T97N

AY-5-1013 . . . .
2513/2140. . . . .
UPD416 . . (MK4116)
MM5314N . . . .
TMS2516 . . . .(2716)
DM8835N . . . .

— LEDS —
Display / Discrete

MAN 2 . . . (TIL305)
DL704, DL707, DL747, DL750
XC556 R-G-Y . . . .
Cliplites . . . .

— IC SOCKETS —

8 pin LP . . . .
14 pin LP . . . .
16 pin LP . . . .
24 pin LP . . . .
40 pin LP . . . .
14 pin WW . . . . . .
16 pin WW . . . . . .
24 pin WW . . . . . .
40 pin WW . . . . . .
14 pin Plug . . . . . .
16 pin Plug . . . . . .
24 pin Plug . . . . . .
TO-3 . . . .
TO-5 . . . . . (3 pin)
M-530-1 . . . .
M-530-8 . . . .

— CAPACITORS —

. . . . Dipped . . . . Tantalum
. . Polyester/Mylar. .
Miniature Aluminum Electrolytic Axial
. . . Ceramic Disc . .

— DIODES —

— TRANSISTORS —

— RESISTORS —
5% — 1/4 Watt
50 pc. Assortmts.

P.C. POTENTIOMETERS

— SWITCHES —

. . . . .Dip . . . . .
. . . .Toggle . . . .
. . . . Slide. . . . .
. . Pushbutton . . .

— CRYSTALS —

— CONNECTORS —

— HEAT SINKS —

— FUSEHOLDERS —

— TEST CLIPS —

— BOOKS —

— KITS —

. . . .Clocks . . . .
. .Thermometer . .
. . Stopwatch . . .
. Function Gen. . .
. Power Supplies. .
. 62-Key Encoded. . Keyboard
. . Hexadecimal . . Encoder Keyboard

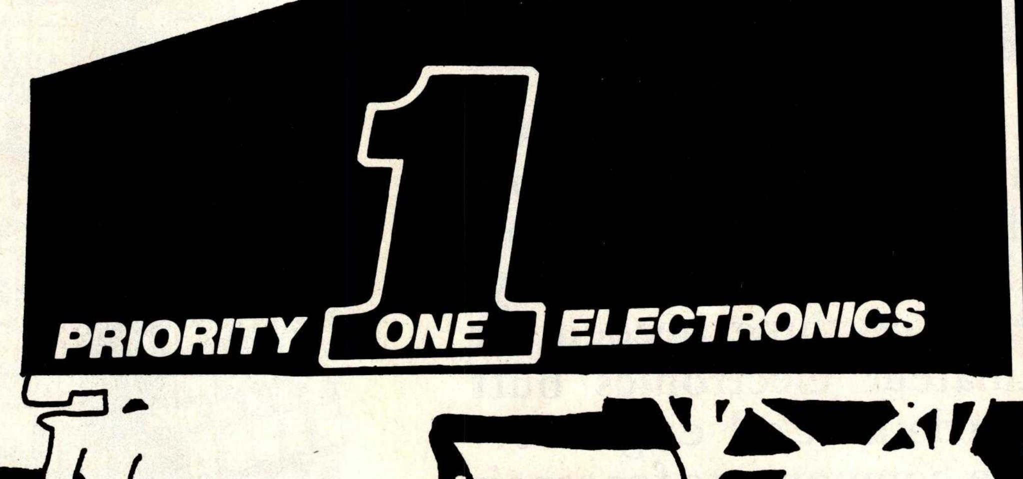
— DIP JUMPERS AND CABLE ASSEMBLIES —

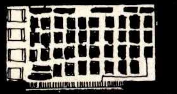
— MISC. ACCESSORIES —

Ask your Distributor to stock  **today!**

Call or write for distributor information:
JIM-PAK ELECTRONICS, 1355 Shoreway Road, Belmont, CA 94002 (415) 595-5936

Circle 205 on inquiry card.





CCS-M-XVI-M

The true 16K Static Ram module for S-100 bus systems. ASSEMBLED & TESTED --100% BURN IN - FEATURES: • Fully static • Uses popular 2114 static RAMS • +5 volt operation only • Bank Select available by bank port and bank byte • Phantom Line capability • Addressable in 4K blocks • 4K blocks can be addressed anywhere with in 64K in 4k increments. • Meets IEEE proposed S-100 signal standards • LED indicators for board selection and bank selection • FR-4 EPOXY PC boards • Solder masked on both sides • Silk screen of part number and part designator.

OUR PRICE

CCS-2016BA 450ns 2MHZ - Reg. Price $349.95 .... $279.95
CCS-2016BB 300ns 4MHZ - Reg. Price - $389.95 .... $309.00
CCS-2016BY Bare Board - only ... $29.95



The VISTA V-80 Disk Drive System

• 23% more storage capacity than TRS-80 • 120 day warranty • 40 track patch at NO CHARGE from VISTA

Single drive system $395.00
Two drive system $770.00
Four drive system $1450.00
Two drive cable $29.95
Four drive cable $39.95

NEW MS-230 DUAL TRACE MINISCOPE 30 MHz BANDWIDTH

1 NLS MS-230 30 MHZ Scope ... $598.15
2 NLS 41-141 10 to 1 Combo Probe $54.00
1 NLS 41-180 Deluxe Leather Case $45.00

LIST PRICE $697.15
MS 230 COMBO PRICE $547.15
SAVE $150.00

AUDIO RESPONSE™ DIGITAL DISPLAY

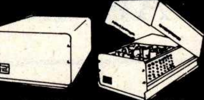
The ROAD RUNNER offers Audio Response...A new dimension in multimeters. Rapid checking of fuses, capacitors, diodes, resistors, transistors, LED's darlingtons...without looking at the meter. The <1V and<2V ranges cause sufficient voltage across the probe tips to forward bias diodes and transistors causing a continuous tone. Similarly, capacitors can be charged until the tone shuts off...thus the approximate value of the capacitor can be measured. The <1 ohm,<10 ohm, and<100 ohm ranges are used in threshold testing of resistors and making continuity tests of PCB's, wire wrap and solder connections, light bulbs, and transformer windings. In addition, the Audio Response function permits the monitoring of incoming digital pulses. The ROAD RUNNER ADMM ™ FEATURES • Six Functions • 29 Ranges • 0.5% Accuracy on DCV • 5 Range Audio Response Function • Color coded easy-to-read front panel and pushbuttons • Full Accessory Line Expands Capability • 0.5" LCD Display • Rugged Case for "Field Use" • RFI Shielded.

ONLY $139.00

WESTON-6100 Digital Multimeter .... @ $139.00
WESTON-6100C Leather Case @ $ 15.95
WES-9740-0279627 VHF RF Voltage Probe .... @ $ 63.00
WES-5768 AC Clamp-on Probe @ $ 57.75
WES-1961 RF Voltage Probe .. @ $ 29.00
WES-9395 50 KV Probe ...... @ $ 38.75
WES-6100-AC 110V AC Adapter .... @ $ 15.00

NEW FROM SAMS BOOKS

192 PAGES TRS-80 ...... $8.95



CALIFORNIA Computer Systems

• S-100 compatible • Industrial/commercial quality construction • Flip-top cover • Excellent cooling capability • 12 slot capability (uses model 2501A) • Input 105, 115, or 125 VAC • Output + 8 VDC20A, + -16 VDC 4A • Active termination of all bus lines • Fan and circuit breaker included • Rugged construction

CCS-2200A Assembled & Tested 35 lbs $399.95
CCS-2200AK Kit 35 lbs. $349.95

MEMORY MEMORY

2102LIPC
Low Power 450ns in lots of 20 ..... $1.10
2102AL-2
Low Power 250ns in lots of 20 ..... $1.25
2114-3L
1Kx4 300ns Low Power .... 8/$50.00
5257-3L
4Kx1 300ns Low Power .... 8/$55.00
2708
8K 450ns EPROM .... 8/$60.00-$8.50 ea.
2716
16K 5 Volt only EPROM
8/$248.00 .... $32.00 ea.

RS232 and "D" SUB-MINIATURE CONNECTORS *

P Plug, Male Type S Socket, Female Type C Cover, Hood

PART NO.	DESCRIPTION	PRICE 1-9	10-24	25-99
CND-DE9P	9 Pin Male	1.60	1.40	1.30
CND-DE9S	9 Pin Female	2.25	2.00	1.90
CND-DE9C	9 Pin Cover	1.50	1.35	1.20
CND-DA15P	15 Pin Male	2.35	2.15	2.00
CND-DA15S	15 Pin Female	3.25	3.10	2.90
CND-DA15C	15 Pin Cover	1.60	1.45	1.30
CND-DB25P	25 Pin Male	2.80	2.60	2.40
CND-DB25S	25 Pin Female	3.60	3.40	3.20
CND-DB51212-1	1 pc.Grey Hood	1.50	1.30	1.10
CND-DB110963-3	2 pc.Grey Hood	1.75	1.50	1.35
CND-DB1226-1A	2 pc.Black Hood	1.90	1.65	1.45

Circle 206 on inquiry card.

TRUCKLOAD SALE

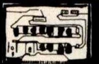


Z-80 STARTER KIT
COMPLETE Z-80 MICROCOMPUTER
SDS-Z80 STARTER KIT
List - $340.00 . . . . Sale - $239.00

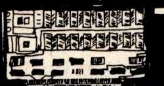
S-100 BUS EDGE CONNECTORS
CG 1 (MSA) Style Card Guides 5/$1.00
Texas Instruments - Gold S-100 Connectors
TIS100 STG Solder Tail . . . . 5/$10.00
TIS100WWG Wire Wrap . . . . 3/$10.00



SD EXPANDORAM
EXPANDABLE TO 64K
USING 4116 RAMS
SDS-EXPANDORAM-16K KIT
List - $385.00 . . . . Sale - $215.00
SDS-EXPANDORAM-32K KIT
List - $550.00 . . . . Sale - $270.00
SDS-EXPANDORAM-48K KIT
List - $715.00 . . . . Sale - $350.00
SDS-EXPANDORAM-64K KIT
List - $880.00 . . . . Sale - $410.00



PROM-100
PROGRAMS 2708, 2716, 2732, 2758, 2516 EPROMS
SDS-PROM-100 KIT
List - $200.00 . . . . Sale - $175.95

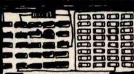


EXPANDOPROM
EXPANDABLE TO 32K
USING 2716 EPROMS
SDS-EXPANDOPROM KIT
List - $200.00 . . . . Sale - $156.00

VDB-8024
80 x 24 I/O MAPPED VIDEO BOARD SDS-VDB-8024 KIT
List - $375.00 . . . . Sale - $315.00

VERSAFLOPPY II
DOUBLE DENSITY DISK CONTROLLER
SDS-VERSAFLOPPY II KIT
List - $350.00 . . . . Sale - $299.00

MPB-100
Z80 CENTRAL PROCESSING UNIT SDS MPB-100 KIT
List - $250.00 . . . . Sale - $199.00



EXPANDORAM II
4 MHz RAM BOARD
EXPANDABLE TO 256K
SDS-EXPANDORAM-II - 16K KIT
List - $470.00 . . . . Sale - $280.00
SDS-EXPANDORAM-II - 32K Kit
List 720.00 . . . . Sale - $360.00
SDS-EXPANDORAM-II - 48K KIT
List $970.00 . . . . Sale - $440.00
SDS-EXPANDORAM-II - 64K KIT
List $1220.00 . . . . Sale - $510.00



SBC-100/200
2 OR 4 MHz SINGLE BOARD COMPUTER
SDS-SBC-100 2MHZ KIT
List-$295.00 . . . . Sale-$235.00
SDS-SBC-200 4MHZ KIT
List-$320.00 . . . . Sale-$255.00

TRS-80/APPLE
MEMORY EXPANSION KITS
from Leading Manufacturers (16K x 1 200/250ns) 4116's RAMS . . . . 8 for $65.00
Add $3.00 for programming jumpers for TRS 80 Keyboard.



VERSAFLOPPY
SINGLE DENSITY DISC CONTROLLER
SDS-VERSAFLOPPY KIT
List - $250.00 . . . . Sale $235.00



ROCKWELL AIM-65
The Rockwell AIM 65 with 4K
RCK-AIM65 4K 8 lbs $445.00
The Rockwell AIM 65 with 1K
RCK-AIM65 1K 8lbs $375.00
4K Assembled--RCK-AIM65-010 . . $85.00
8K Basic in ROM RCK-AIM65-020$100.00

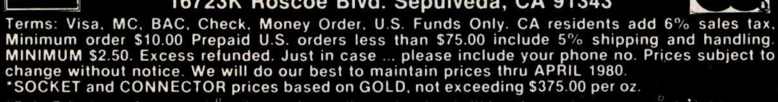


CENTRONICS
730 - 1 Dot Matrix Printer
List - $995.00 . . . Sale - $850.00
SAVE $150.00

NOVATION CAT
ACOUSTIC COUPLER/MODEM
List - $199.00 . . . . Sale $169.00

ORDER TOLL FREE
1-800-423-5633
except CA., AK., HI., CALL
(213) 894-8171





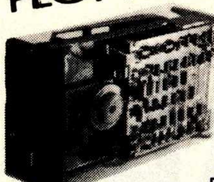
PRIORITY ONE ELECTRONICS
16723K Roscoe Blvd. Sepulveda, CA 91343

Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00 Prepaid U.S. orders less than $75.00 include 5% shipping and handling. MINIMUM $2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru APRIL 1980.
*SOCKET and CONNECTOR prices based on GOLD, not exceeding $375.00 per oz.
*Sale Prices are for prepaid orders only credit card orders will be charged appropriate freight

FOR MORE INFORMATION SEE OUR 52 PAGE AD in JANUARY BYTE OR SEND $1.00 FOR CATALOG
• Sale Prices are for prepaid orders only • Quantities are limited, subject to prior sale • CREDIT CARD ORDERS WILL BE CHARGED APPROPRIATE FREIGHT

Circle 206 on inquiry card.

FLOPPY SYSTEMS



8" Siemens FDD120-8D All Siemens options included in this drive may be configured hard or soft and single or double density. We find this to be an extremely reliable drive. **$430.00** Fully Shugart compatible.

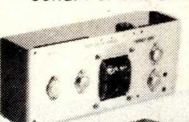
5¼" BASF Magical Miniature Mini drive only 2/3 the size of others is reliable and durable and quickly gaining in popularity with our customers. Single or dual density fast access times **$259.00**

Tarbell... single density. A&T, $265 $265, kit, $179. A&T $219 w/ purch. of 2 drives. Tarbell double density, DMA, $399. Delta Double density, $399. Micromation double density w/programmable UART for RS-232 port $495. Sorrento Valley single density for Apple, $399.

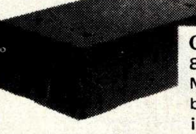


Cable Kits For 8" Drives with 10' 50 cond. cable and conn ectors. Also power cable and connectors. Flat cable assem if you wish. For one drive 27.50, two 33.95, three 38.95

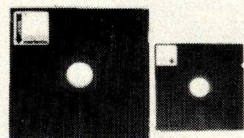
Cable Kits for 5¼" Drives as above, but 34 cond. For one drive **24.95**, two **29.95**.



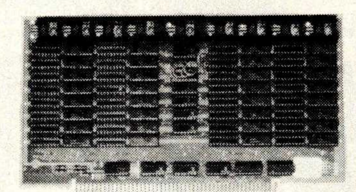
"Power One" Model CP206 Power Supply adequate for at least two drives. 2.8A/24V 2.5A/5V, 0.5A/-5V beautiful quality. **$99.00**



CABINETS for FDD120 and 801R drives, or CP206 supply. Matte finish in mar resistant black epoxy paint and stacking design **29.95**



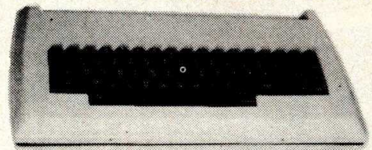
DISKETTES (Mrx, Verbatim, Georgia Magnetics)
8" $39.95/10
5¼" $34.95/10



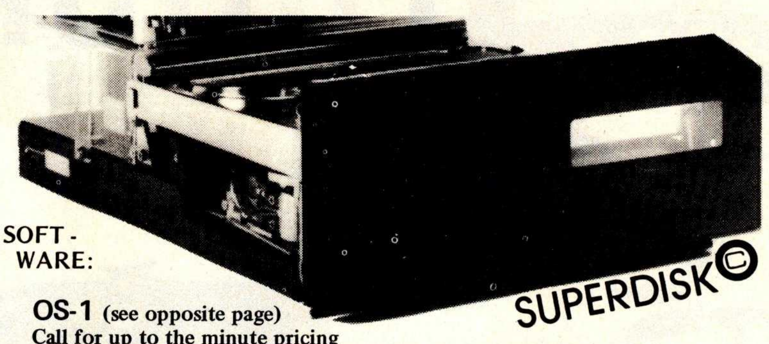
STATIC RAM MEMORY, S-100

32K - $549.00 16K - $349.00

"BACK TO SCHOOL" KEYBOARD SPECIAL



CHERRY "PRO" Keyboard $119.00
Streamlined Custom Enclosure $34.95
BOTH ONLY $134.95 !!!!!!!!!



10MBy DRIVE $3300

S-100 DMA CONTROL

POWER UNIT $395.00

SOFT-WARE:

OS-1 (see opposite page) Call for up to the minute pricing on S-100 DMA controller, LSI-11 controller, cabinetry, etc.

PS: OS-1 runs on the TRS-80, and can transform it from a toy computer to a real business machine !!!

For the first time in something like 10 years, a new STANDARD in removable media has evolved. Selected by Datapoint, and others who have not yet announced, this drive is beautifully simple and easy, if not trivial to maintain. 920kBy/sec. transfer rate, 3600 RPM 39 lbs and only 125 Watts.

Daisy Wheel Printers

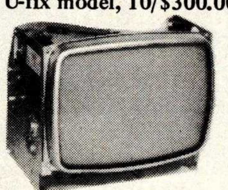
Qume Sprint 3\45

PRINTER (factory warr.)	$1499.00
POWER SUPPLY (Boschert)	349.00
(shown mounted on rear of printer)	
COMBINATION SPECIAL	$1699.00
Cases available	200.00
S-100 interface card	149.00

DATA DISPLAY MONITORS

Used 12" Sylvania monitors. Composite Video, 15 MHz, 120VAC. Rebuilt with NEW P39 anti-glare tube $119.00 New P4, 109.00, used P4 79.00. U-fix model, 10/$300.00



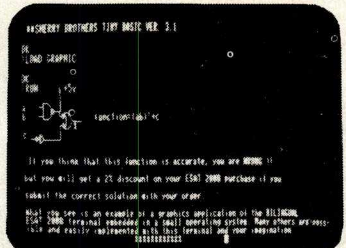


"OEM STYLE" as above, will fit any case. (Both versions serviced by qualified tech). Identical to above but subtract $12.00

Electrolabs
POB 6721, Stanford, CA 94305
415-321-5601 800-227-8266
Telex: 345567 (Electrolab Pla)
Visa MC Am. Exp.

ESAT 200B

BI-LINGUAL 80x24 COMMUNICATING TERMINAL
Scrolling, full cursor, bell, 8x8 matrix, 110 - 19,200 baud, Dual Font Applications. Arabic & Hebrew, Multilingual Data Entry Forms Drawing, Music, & Switchyards. $349.00



Televideo 912B ($860.00) **Televideo 920C ($1020.00)**

New!



TELEVIDEO 912B
- Upper & lower case
- Adjustable baud rate
- 80 x 24
- Editing capabilities
- Printer port
- Second page memory & much much more

TELEVIDEO 920C
- Same features as 912B PLUS
- Line & character insert/delete
- Special function keys

SOCKET SPECIAL

BURNDY

"Won't Let Go"

Low Profile

Solder Tail

1 CENT/ Pin !! (0.75/1000's)

8 14 16 18 20 22 24 28 40

Circle 207 on inquiry card.

CP/M* Source Code -- FREE! *when you purchase* **"OS-1"**

Electrolabs' new operating system for the Z-80 designed to have exactly the appearance of UNIX, including virtual I/O, "set TTY", a tree and a shell, filters and pipes PLUS total compatability with CP/M software!**

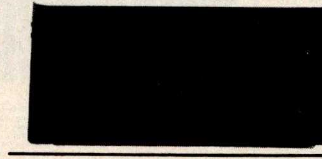
OS-1© FEATURES

(Because OS-1 is truly a comprehensive "OS", and not merely a file handling "DOS", we have changed the name from "Superdos" to "OS-1")

VIRTUAL I/O - copy with a single command between floppy and hard disk, or from TTY to printer to tape to disk... etc., etc. No messy I/O routines to write, & no awkward transfers.
SECURITY - 9 modes of file protection, user and login protection.
MULTI-USER - up to 256 passwords. (non-simultaneous users)
16MBy FILE SIZE - but no limit to no. of directories per device, thus allowing EASY implementation of gigantic storage devices.
"SET TTY" - for printer or crt: tabs, page width, buffer, cursor, UC/LC, fonts, formfeed, arbitrary control characters etc., etc.
"LOGIN" - automatically executes user selected programs and "set TTY".
OCCUPIES 12KBy - only 50% larger than CP/M, but 500% more features.
CP/M & CDOS COMPATABLE - your library is guaranteed to run!

*(Naturally, we are not giving away the version of CP/M written by Digital Research. Please pardon our pun, but they might object. What we ARE giving you is a greatly enhanced version of CP/M which resides on OS-1, and allows the user of OS-1 to run any and all of his programs, packages or system utilities which are already running on CP/M. We give you the source code at no charge so that you may modify any part of the CP/M to suit your own system requirements. At no charge, you also receive the enhancement allowing 4MBy files instead of 256K.)

OS-1 (with debugger, linker and screen oriented editor	**$199.00**
Update service, per year	**29.00**
Symbolic Debugger	**150.00**
MACRO-Assembler (Creates relocatable code)	**150.00**
"C" Compiler	**660.00**
FORTRAN Compiler	**100.00**
BASIC Compiler (very fast)	**350.00**



PAPER TIGER

IDS MODEL 440

- 8 Software Selectable Character Sizes
- Parallel & Serial Interface
- 98 ASCII Character set, upper & Lower case
- Forms length control
- Tractor Feed $949.00

Graphics option with 2K CRT screen buffer add $199.00

DYNAMIC DEVICES MODEM



- Acoustically coupled modem assembly set
- Asynchrous 0-300 Baud
- Switchable originate or answer modes
- Operates full or half duplex mode
- 15 minute assembly $149.95

SPRINGTIME IC SPECTACULAR

(While Supply Lasts)

MEMORY & EPROM

2114	$ 5.99
2114-2	6.99
pd 411	2.50
2107	2.00

4116 (set of 8, 16K, memory expansion for TRS-80, Apple, Exidy)	$69.00
2708	8.95
2716	35.00
2516	35.00

2732	95.00
8748-8	49.00
8755-8	49.00

CPU

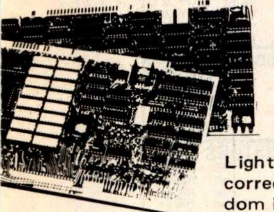
6502	6.25
Z-80	9.95
Z-80A	12.05
8080A	8.99
8085	22.00
8741	79.00

FLOPPY CONTROLLERS

1771	$26.95
1791	37.95
Pd372	39.00

MISCELLANEOUS (CALL US!!)

ELECTROLABS
POB 6721 Stanford, CA 94305
415-321-5601 800-227-8266
Telex: 345567 (Electrolab Pla)



Graphics

High Resolution 480 x 512 for B&W and Color Imaging and Graphics

Light pen, A-D, D-A, TV synchro (needs no time base correction or adjustment with anything between random interface & NTSC commercial standard). T.V. single frame grabber ("snapshot"). Up to 1 Byte of attributions per pixel.

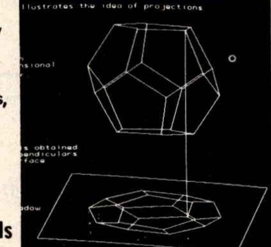
LSI-100 & S-100 applied to:

Graphic Presentation — such as computer generated animation & other graphic displays up to 256 colors & up to 256 b&w gray scales. **Image Analysis** — using built-in FRAME GRABBER, for medical image enhancement, contour analysis, & pattern recognition. **Commercial TV Tilting & Advertising** — using synchronization capability. **Interactive graphics** — using light pen accessory.

BASIC CONFIGURATION —
LSI-11 $1995. S-100 $1265.
For TRS-80/Exidy Add $595.00
Includes: Data Board - 32K (480 x 512 x 1 pixel) D-A 16 level video generator. Video Synchronization Circuitry. Address Control & Timing Board.

FEATURES — High speed. DMA or 2KBy window memory mapped interface. Full NTSC commercial color capability. Low power consumption. Excellent Software

Options — Accessories — Software
Options include: light pen, auxilliary outputs, text mode, memory and much more. Accessories include: b&w and color cameras and monitors. Software: "Plot" 2D or 3D, "Tilting", "Contour", "Image Enhancement", "Vector Curve Generation".



Call for price and details

*CPM and **UNIX trademarks of Digital Research and Western Electric respectively.

Circle 207 on inquiry card.

MATCHMAKER TECHNOLOGY

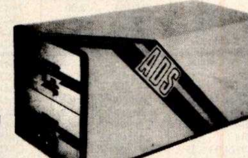
TURNKEY DISK SUBSYSTEMS

DISK IS IN!!!

✓SORCERER
✓TRS-80
✓APPLE
✓HPIB
✓PET

For those who wish to avoid the aggravation, fussing, irritation, annoyance etc., of assembling your own subsystem, plug in and GO!!!





APPLE

FEATURES:
- 2 8" Floppy DISK DRIVES (Single Sided)
- Color Coordinated Cabinet with Power Supply
- Expanded version of APPLE-DOS
- Single Density Disk Controller
- Full Cabling, Connectors + Documentation
- Assembled and Tested
- Plug In and GO!!!

OPTIONS:
- 2 8" Double Sided Drives (In place of Single Sided)
- 16K Internal Memory Expansion Kit 69.00

PET

Prices and specifications same as for APPLE except PET Operates via PET-DOS

TRS-80

Prices and specifications same as for SORCERER with following exceptions:
- Expansion Interface necessary
- Space for up to 48K plug-in dynamic memory on Controller Card
- Software package as above

SORCERER

FEATURES:
- 2 8" Single Sided Floppy Disk Drives
- Single and/or Double Density
- Color Coordinated Cabinet with Power Supply
- Full RS-232 Interface
- OS-1 Disk Operating System (Fully CP/M compatible) CP/M is a registered trademark of Digital Research
- Full Cabling, Connectors + Documentation
- Assembled and Tested
- One S-100 Slot available for Memory Expansion
- Plug In and GO!!!

OPTIONS:
- 2 8" Double Sided Drives (In place of Single Sided)
- 32K Dynamic RAM Memory Board, Assembled and Tested
- 16K Dynamic RAM Internal Memory Expansion Kit $ 69.00
- Deluxe Business Software package includes: C BASIC, WORD PROCESSING SOFTWARE, INTERACTIVE "Big 4": General Ledger, Accts. Payable, Accts. Rec. and Payroll
- 10 MBY Removeable Hard Disk — Call for Details

ANOTHER Fine Product brought to you exclusively by the folks at:

In California: 415-321-5601
Outside Cal: 800-227-8266

Electrolabs
POB 6721, Stanford, Ca. 94305

Worldwide:
TLX: 345567 Electrolabs PLA

7400 TTL

Part	Price
SN7400N	.20
SN7401N	.20
SN7402N	.20
SN7403N	.20
SN7404N	.25
SN7405N	.20
SN7406N	.29
SN7407N	.29
SN7408N	.20
SN7409N	.20
SN7410N	.18
SN7411N	.25
SN7412N	.25
SN7413N	.40
SN7414N	.70
SN7416N	.25
SN7417N	.25
SN7420N	.20
SN7421N	.29
SN7422N	.39
SN7423N	.25
SN7425N	.29
SN7426N	.29
SN7427N	.25
SN7429N	.39
SN7430N	.20
SN7432N	.25
SN7437N	.25
SN7438N	.40
SN7439N	.25
SN7440N	.20
SN7441N	.89
SN7442N	.59
SN7443N	.75
SN7444N	.75
SN7445N	.75
SN7446N	.69
SN7447N	.59
SN7448N	.79
SN7450N	.20
SN7451N	.20
SN7453N	.20
SN7454N	.20
SN7459A	.25
SN7460N	.20
SN7470N	.29
SN7472N	.29
SN7473N	.35
SN7474N	.35
SN7475N	.49
SN7476N	.35
SN7479N	5.00
SN7480N	.50
SN7482N	.99
SN7483N	.69
SN7485N	.89
SN7486N	.35
SN7489N	1.75
SN7490N	.45
SN7491N	.59
SN7492N	.43
SN7493N	.43
SN7494N	.65
SN7495N	.65
SN7496N	.65
SN7497N	3.00
SN74100N	1.25
SN74107N	.35
SN74109N	.59
SN74116N	1.95
SN74121N	.35
SN74122N	.39
SN74123N	.59
SN74125N	.49
SN74126N	.49
SN74132N	.75
SN74136N	.75
SN74141N	.79
SN74142N	2.95
SN74143N	2.95
SN74144N	2.95
SN74145N	.79
SN74147N	1.95
SN74148N	1.29
SN74150N	1.25
SN74151N	.59
SN74152N	.59
SN74153N	.59
SN74154N	1.50
SN74155N	.79
SN74156N	.79
SN74157N	.65
SN74160N	.89
SN74161N	.89
SN74162N	1.95
SN74163N	.89
SN74164N	.89
SN74165N	.89
SN74166N	1.25
SN74167N	1.95
SN74170N	1.59
SN74172N	6.00
SN74173N	1.25
SN74174N	1.00
SN74175N	1.00
SN74176N	.79
SN74177N	.79
SN74179N	1.95
SN74180N	.79
SN74181N	1.95
SN74182N	.79
SN74184N	1.95
SN74185N	1.95
SN74186N	9.95
SN74188N	3.95
SN74190N	1.25
SN74191N	1.25
SN74192N	.79
SN74193N	.79
SN74194N	.89
SN74195N	.69
SN74196N	.89
SN74197N	.89
SN74198N	1.49
SN74199N	1.49
SN74S200	4.95
SN74251N	.99
SN74279N	.79
SN74283N	2.25
SN74284N	3.95
SN74285N	3.95
SN74365N	.69
SN74366N	.69
SN74367N	.69
SN74368N	.69
SN74390N	1.95
SN74393N	1.95

CMOS

Part	Price
CD4000	.39
CD4001	.39
CD4002	.39
CD4006	1.19
CD4007	.25
CD4009	.49
CD4010	.49
CD4011	.39
CD4012	.25
CD4013	.49
CD4014	1.39
CD4015	1.19
CD4016	.59
CD4017	1.19
CD4018	.99
CD4019	.49
CD4020	1.19
CD4021	1.39
CD4022	1.19
CD4023	.29
CD4024	.79
CD4025	.23
CD4026	2.95
CD4027	.69
CD4028	.89
CD4029	1.49
CD4030	.49
CD4035	.99
CD4040	1.49
CD4041	1.49
CD4042	.99
CD4043	.89
CD4044	.89
CD4046	1.79
CD4047	2.50
CD4048	1.35
CD4049	.49
CD4050	.69
CD4051	1.19
CD4053	1.19
CD4056	2.95
CD4059	9.95
CD4060	1.49
CD4066	.79
CD4068	.39
CD4069	.45
CD4070	.55
CD4071	.49
CD4072	.49
CD4076	1.39
CD4081	.39
CD4082	.39
CD4093	.99
CD4098	1.19
MC14409	14.95
MC14410	14.95
MC14411	14.95
MC14419	4.95
MC14433	13.95
MC14506	.75
MC14507	.99
MC14562	11.95
MC14583	2.49
CD4508	3.95
CD4510	1.39
CD4511	1.29
CD4515	2.95
CD4518	1.29
CD4520	1.29
CD4566	2.25

74C00

Part	Price
74C00	.39
74C02	.39
74C04	.45
74C08	.49
74C10	.39
74C14	1.95
74C20	.39
74C30	.39
74C42	1.95
74C48	2.49
74C73	.89
74C74	.89
74C85	2.49
74C90	1.95
74C93	1.95
74C95	1.95
74C107	1.25
74C151	2.90
74C154	3.00
74C157	2.15
74C160	2.49
74C161	2.49
74C163	2.49
74C164	2.49
74C173	2.60
74C192	2.49
74C193	2.49
74C195	2.49
74C922	7.95
74C923	6.25
74C925	8.95
74C926	8.95
80C95	1.50
80C97	1.50

LINEAR

Part	Price
78MG	1.75
LM106H	.99
LM300H	.80
LM301CN/H	.35
LM302H	.75
LM304H	1.00
LM305H	.60
LM307CN/H	.35
LM308CN/H	1.00
LM309H	1.10
LM309K	1.25
LM310CN	1.95
LM311N/H	.90
LM312H	1.95
LM317K	6.50
LM318CN/H	1.50
LM319N	1.30
LM320K-5	1.35
LM320K-5.2	1.35
LM320K-12	1.25
LM320K-15	1.35
LM320K-18	1.35
LM320K-24	1.35
LM320T-5	1.25
LM320T-5.2	1.25
LM320T-8	1.25
LM320T-12	1.25
LM320T-15	1.25
LM320T-18	1.25
LM320T-24	1.25
LM323K-5	5.95
LM324N	1.49
LM339N	.99
LM340K-5	1.35
LM340K-6	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-18	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-6	1.25
LM340T-8	1.25
LM340T-12	1.25
LM340T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM358N	1.00
LM370N	1.95
LM373N	3.25
LM377N	4.00
LM380N	1.25
LM380CN	.99
LM381N	1.79
LM382N	1.79
NE501N	8.00
NE510A	6.00
NE529A	4.95
NE531H/V	3.95
NE536T	6.00
NE540	6.00
NE544N	4.95
NE550N	1.30
NE555V	.39
NE556N	.99
NE560B	5.00
NE562B	5.00
NE565N/H	1.25
NE566CN	1.75
NE567V/H	.99
NE570N	4.95
LM703CN/H	.69
LM709N/H	.29
LM710N	.79
LM711N	.39
LM723N/H	.55
LM733N	1.00
LM739N	1.19
LM741CN/H	.35
LM741-14N	.39
LM747N/H	.79
LM748N/H	.39
LM1310N	1.95
LM1458CN/H	.59
MC1488N	1.95
MC1489N	1.95
LM1496N	.95
LM1556V	1.75
MC1741SCP	3.00
LM2111N	1.95
LM2901N	2.95
LM3053N	1.50
LM3065N	1.49
LM3900N(3401)	.59
LM3905N	1.49
LM3909N	1.25
MC5558V	.59
8038B	4.95
LM75450N	.49
75451CN	.39
75452CN	.39
75453CN	.39
75454CN	.39
75491CN	.79
75492CN	.89
75493N	.89
75494CN	.89
RC4136	1.25
RC4151	3.95
RC4194	4.95
RC4195	4.49

74LS00TTL

Part	Price
74LS00	.35
74LS01	.35
74LS02	.35
74LS03	.35
74LS04	.42
74LS05	.42
74LS08	.35
74LS09	.42
74LS10	.35
74LS11	.75
74LS13	.59
74LS14	1.25
74LS15	.35
74LS20	.35
74LS21	.35
74LS22	.35
74LS26	.35
74LS27	.35
74LS28	.35
74LS30	.35
74LS32	.42
74LS37	.45
74LS40	.35
74LS42	1.05
74LS47	1.05
74LS51	.29
74LS54	.29
74LS55	.29
74LS73	.54
74LS74	.54
74LS75	.71
74LS76	.54
74LS78	.49
74LS83	1.05
74LS85	1.50
74LS86	.54
74LS90	.71
74LS92	.90
74LS93	.90
74LS95	.99
74LS96	1.15
74LS107	.54
74LS109	.54
74LS112	.54
74LS123	1.50
74LS125	1.05
74LS132	.99
74LS136	.59
74LS138	1.05
74LS139	1.05
74LS151	1.05
74LS155	1.05
74LS157	1.05
74LS160	1.15
74LS161	1.39
74LS162	1.25
74LS163	1.39
74LS164	1.50
74LS175	1.25
74LS181	2.49
74LS190	1.39
74LS191	1.39
74LS192	1.39
74LS193	1.39
74LS194	1.39
74LS195	1.39
74LS253	1.25
74LS257	1.05
74LS258	1.75
74LS260	.83
74LS279	.90
74LS367	.75
74LS368	.75
74LS670	2.49

Cromemco incorporated

Z80-4MHz Single Card Computer

Cromemco's Single Card Computer is a complete computer which brings the power of the Z-80 and the flexibility of the S-100 bus to the dedicated computer environment.

The card offers 4 MHz operation, 8K bytes of on-board 2716 PROM, and 1K byte of static RAM memory. This stand-alone card also provides an RS-232 (or 20mA current loop) serial interface with programmable baud rates to 76,800, vectored interrupts, 24 bits of bidirectional parallel I/O, and 5 programmable timers. Only a power supply and PROM software are required for operation. The Single Card Computer is assembled and tested (Model SCC-W) for $450. The Monitor and Control BASIC are available in two ROM's (Model MCB-216) for $90.

SCC-W (Assembled) **$450.00**

Processor: 4MHz Z-80
Instruction Set: 158 instructions incl. the 78 instructions of the 8080.
ROM Capacity: 8K Bytes located from address 0000 to 1FFF.
ROM Type: Intel 2716 PROM or equivalent.
RAM Capacity: 1K Bytes located from address 2000 to 23FF
RAM Type: 4045, Static

Serial I/O Ports:
I/O Levels: RS-232 or 20mA current loop
Baud Rates: 110 to 76,800 (software selectable)
Parallel Ports:
Input Port: 24 bits bidirectional
Output Port: 24 bits bidirectional
Input Load: One TTL equivalent
Output Drive: 20 TTL loads
Interval Timers:
Number of timers: 5

Timer range: 0-16.32 milliseconds (software sel.)
Timer resolution: 64 microseconds
Vectored Interrupts:
No. of restart locations (Z-80 mode): 65,536
General Information:
UART type: 5501 Bus: S-100
Power requirements: +8V at 1.4A, +18V at 70mA, −18V at 25mA
Operating environment: 0-55°C

DISCRETE LEDS

Part	Size	Color	Price
XC556R	.200"	red	5/$1
XC556G	.200"	green	4/$1
XC556Y	.200"	yellow	4/$1
XC556C	.200"	clear	4/$1
XC22R	.200"	red	5/$1
XC22G	.200"	green	4/$1
XC22Y	.200"	yellow	4/$1
MV10B	.170"	red	4/$1
MV50	.085"	red	6/$1
XC209R	.125"	red	5/$1
XC209G	.125"	green	4/$1
XC209Y	.125"	yellow	4/$1
XC526R	.185"	red	5/$1
XC526G	.185"	green	4/$1
XC526Y	.185"	yellow	4/$1
XC526C	.185"	clear	4/$1
XC111R	.190"	red	5/$1
XC111G	.190"	green	4/$1
XC111Y	.190"	yellow	4/$1
XC111C	.190"	clear	4/$1

INFRA-RED LED
¼"x¼"x1/16" flat 5/$1

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.75	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.49	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.49	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL33B	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	.99
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	1.50
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	1.50
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

Part	Price	Part	Price
CA3013T	2.15	CA3082N	2.00
CA2023T	3.25	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	1.25	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

Part	Price
MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7-seg. LED driver	1.50
MM5309	4.95

CLOCK CHIPS

Part	Price
MM5309	4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998a	4.95
CT 7001	6.95

MOTOROLA

Part	Price
MC1408L7	4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 OHM, 27 OHM	12 OHM, 33 OHM	15 OHM, 39 OHM	18 OHM, 47 OHM	22 OHM, 56 OHM	50 PCS	$1.75
ASST. 2	5 ea.	68 OHM, 180 OHM	82 OHM, 220 OHM	100 OHM, 270 OHM	120 OHM, 330 OHM	150 OHM, 390 OHM	50 PCS	1.75
ASST. 3	5 ea.	470 OHM, 1.2K	560 OHM, 1.5K	680 OHM, 1.8K	820 OHM, 2.2K	1K, 2.7K	50 PCS	1.75
ASST. 4	5 ea.	3.3K, 8.2K	3.9K, 10K	4.7K, 12K	5.6K, 15K	6.8K, 18K	50 PCS	1.75
ASST. 5	5 ea.	22K, 56K	27K, 68K	33K, 82K	39K, 100K	47K, 120K	50 PCS	1.75
ASST. 6	5 ea.	150K, 390K	180K, 470K	220K, 560K	270K, 680K	330K, 820K	50 PCS	1.75
ASST. 7	5 ea.	1M, 2.7M	1.2M, 3.3M	1.5M, 3.9M	1.8M, 4.7M	2.2M, 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage — Add 5% plus $1 Insurance (if desired)

Spec Sheets — 25¢
1980 Catalog Available — Send 41¢ stamp

FREE 1980 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME
(415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

4-80

TELEPHONE/KEYBOARD CHIPS

Part	Description	Price
AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-9200	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	7.95
74C923	Keyboard Encoder (20 keys)	6.25

ICM CHIPS

Part	Description	Price
ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

Part	Description	Price
MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alpha Control Char. Gen	13.50

MISCELLANEOUS

Part	Description	Price
TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.95
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block **(Special)**	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set
MC14433P	3½ Digit A/D Converter	13.95

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
49¢ each

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power - Programmable
$3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

Part	Price	Part	Price	Part	Price
XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	4.95
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00
1N751	5.1	400m	4/1.00
1N752	5.6	400m	4/1.00
1N753	6.2	400m	4/1.00
1N754	6.8	400m	4/1.00
1N757	9.0	400m	4/1.00
1N759	12.0	400m	4/1.00
1N959	8.2	400m	4/1.00
1N965	15	400m	4/1.00
1N5232	5.6	500m	28
1N5234	6.2	500m	28
1N5235	6.8	500m	28
1N5236	7.5	500m	28
1N5242	12	500m	28
1N5245	15	500m	28
1N456	25	40m	6/1.00
1N458	150	7m	6/1.00
1N485A	180	10m	5/1.00
1N4001	50 PIV	1 AMP	12/1.00
1N4002	100 PIV	1 AMP	12/1.00
1N4003	200 PIV	1 AMP	12/1.00
1N4004	400 PIV	1 AMP	12/1.00
1N4005	600 PIV	1 AMP	10/1.00
1N4006	800 PIV	1 AMP	10/1.00
1N4007	1000 PIV	1 AMP	10/1.00
1N3600	50	200m	6/1.00
1N4148	75	10m	15/1.00
1N4154	35	10m	12/1.00
1N4733	5.1	1w	28
1N4734	5.6	1w	28
1N4735	6.2	1w	28
1N4736	6.8	1w	28
1N4738	8.2	1w	28
1N4742	12	1w	28
1N4744	15	1w	28
1N1183	50 PIV	35 AMP	1.60
1N1184	100 PIV	35 AMP	1.70
1N1185	150 PIV	35 AMP	1.70
1N1186	200 PIV	35 AMP	1.80
1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C36M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

Part	Price	Part	Price	Part	Price
C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
		2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
10 pf	.05	.04	.03	.001μF	.05	.04	.035
22 pf	.05	.04	.03	.0047μF	.05	.04	.035
47 pf	.05	.04	.03	.01μF	.05	.04	.035
100 pf	.05	.04	.03	.022μF	.06	.05	.04
220 pf	.05	.04	.03	.047μF	.06	.05	.04
470 pf	.05	.04	.035	.1μF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

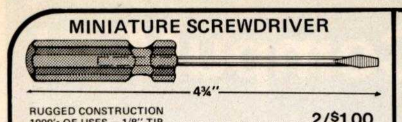
	1-9	10-99	100+		1-9	10-99	100+
.1/35V	.39	.31	.25	1.5/35V	.41	.33	.26
.15/35V	.39	.31	.25	2.2/35V	.51	.41	.33
.22/35V	.39	.31	.25	3.3/25V	.53	.43	.34
.33/35V	.39	.31	.25	4.7/25V	.63	.51	.41
.47/35V	.39	.31	.25	6.8/25V	.79	.63	.50
.68/35V	.39	.31	.25	15/25V	1.39	1.12	.89
1.0/35V	.39	.31	.25	22/6V	.79	.63	.50

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead	1-9	10-99	100+	Radial Lead	1-9	10-99	100+
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

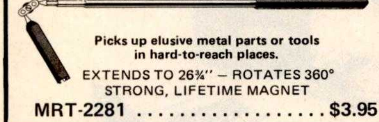
Circle 208 on inquiry card.

MINIATURE SCREWDRIVER



RUGGED CONSTRUCTION
1000's OF USES – 1/8'' TIP .... 2/$1.00

MAGNETIC RETRIEVER TOOL

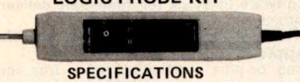


Picks up elusive metal parts or tools in hard-to-reach places.
EXTENDS TO 26¾'' – ROTATES 360° STRONG, LIFETIME MAGNET

MRT-2281 .... $3.95

CSC CONTINENTAL SPECIALTIES

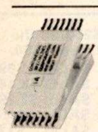
LOGIC PROBE KIT



SPECIFICATIONS
Input Impedance: 300,000 Ohms.
Thresholds: "Lo" 30%Vcc – "Hi" 70%Vcc
Maximum Speed: 300 nsec., 1.5MHz
Input Protection: ±50VDC continuous 117VAC for 15 sec.
Power: 30mA @5V – 40mA @ 15V – 25V max. reverse voltage protected; 36'' cable with color coded clips included.
Operating Temp.: 0-50°C.
Dimensions: 5.8L x 1.0W x 0.7D in. (147 x 25 x 18mm)
Weight: 30 oz. (85 gm)

LPK-1 .... $21.95/Kit

Proto Clips



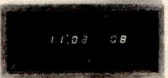
14-PIN CLIP	PC-14	$ 4.50
16-PIN CLIP	PC-16	$ 4.75
24-PIN CLIP	PC-24	$10.00
40-PIN CLIP	PC-40	$16.00

Proto Boards



PB-6	$17.95
PB-100	19.95
PB-101	22.95
PB-102	26.95
PB-103	44.95
PB-104	55.95
PB-203	99.95
PB-203A	155.00
PB-203A-Kit	131.00

Jumbo 6-Digit Clock Kit



- Four .630''ht. and two .300''ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115VAC operation
- 12 or 24 hr. operation
- Includes all components, case and wall transformer
- Size: 6¾ x 3⅛ x 1¾

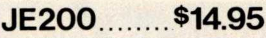
JE747 .... $29.95

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾'' x 3-1/8'' x 1¾''

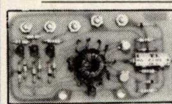
JE701
6-Digit Clock Kit $19.95

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½'' x 5'' x 2''H



JE200 .... $14.95



ADAPTER BOARD –Adapts to JE200– ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal high speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½'' x 2'' x 9/16''H

JE205 .... $12.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES		
8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. 1/0 (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. 1/0 (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95
6800/6800 SUPPORT DEVICES		
MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25
MICROPROCESSOR CHIPS—MISCELLANEOUS		
Z80(780C)	CPU	$13.95
Z80A(780-1)	CPU	15.95
CDP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95
SHIFT REGISTERS		
MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49
UART'S		
A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS		
M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00
ROM'S		
2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

RAM'S			
1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin 250ns	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00
PROM'S			
1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516 (2716)	16K*	EPROM	39.95
	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716 T.I	16K**	EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

JE600 HEXADECIMAL ENCODER KIT



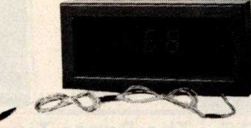
FEATURES:
- Full 8 bit latched output for microprocessor use
- 3 User Define keys with one being bistable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin 1C connector
- Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 .... $59.95
Hexadecimal Keypad only $14.95

DIGITAL THERMOMETER KIT



- Dual sensors—switching control for indoor/outdoor or dual monitoring
- Continuous LED .8'' ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter incl.
- Size: 3-1/4''H x 6-5/8''W x 1-3/8''D

JE300 .... $39.95

62-Key ASCII Encoded Keyboard Kit



The JE610 62-Key ASCII Encoded Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and –12V @ 10mA for operation.

FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

JE610 ..... $79.95
62-Key Keyboard only . . $34.95

HICKOK LX303 Portable LCD Digital Multimeter



- Big ½ inch high, 3½ Digit Liquid Crystal Display
- Over 200 Hours of operation with a 9V battery
- Automatic zero, polarity and overrange indication
- 100mV DC F.S. sensitivity
- 1% basic accuracy
- 19 ranges and functions
- Rugged Cycolac® case and removable cover, stores test lead set.
- Full one year warranty.

SPECIFICATIONS: DC volts (5 ranges): 0.1mV to 1000V; Accuracy ±0.5% rdg ±0.5% f.s.; Input imped: 10MΩ. Max. input 1kV except 500V on 200mV range.
AC Volts (40Hz to 5kHz): 0.1V to 600V; Accuracy: ±1.0% rdg ±0.5% f.s. (–2dB max. at 5kHz); Max. input: 600V.
Resistance (6 Low Power Ranges): 0.1 to 20MΩ; Accuracy: ±0.5% rdg ±0.5% f.s. (±1.5% rdg on 20MΩ range); input protected to 120VAC all ranges.
DC Current (6 ranges): 01nA to 100mA; Accuracy: ±1.0% rdg ±0.5% f.s.
Dimensions and Weight: 5-7/8'' x 3-3/8'' x 1-3/4'', 8 oz.; POWER: 9V battery (not included) or Hickok AC adapter; READ RATE: 3/sec.

LX303 Digital Multimeter $74.95

PART NO.	DESCRIPTION	PRICE
RC-3	115V AC ADAPTER	7.50
CC-3	PADDED CARRYING CASE	7.50
VP-10	X10 DC PROBE ADAPTER (Up to 10K)	14.95
VP-40	40kV DC PROBE	35.00
CS-1	10 Amp DC Current Shunt	14.95

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage – Add 5% plus $1 Insurance (if desired)

Spec Sheets – 25¢
1980 Catalog Available – Send 41¢ stamp

FREE 1980 CATALOG



PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

4-80

The Incredible "Pennywhistle 103"



$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method ..... Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate .... 300 Baud.
Data Format .... Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies ... 2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies .. Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity .... –46 dbm accoustically coupled.
Transmit Level .... –15 dbm nominal. Adjustable from –6 dbm to –20 dbm.
Receive Frequency Tolerance ... Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface .... EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements .... 120 VAC, single phase, 10 Watts.
Physical .... All components mount on a single 5'' by 9'' printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- 8 each UPD416-1 (16K Dynamic Rams) 250NS
- Documentation for conversion

TRS-16K $75.00

ok JUST WRAP™



- 30 AWG wire
- Daisy chain or point-to-point
- No stripping or slitting required—just wrap
- .025'' square posts
- Built-in cut off
- Includes 50 ft. wire

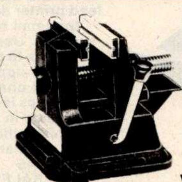
Part No.	Wire Color	Price
JW-1-B	Blue	$14.95
JW-1-W	White	14.95
JW-1-Y	Yellow	14.95
JW-1-R	Red	14.95

JUST WRAP™ Replacement Wire

Part No.	Color		Price
R-JW-B	Blue	50 ft. roll	$2.98
R-JW-W	White	50 ft. roll	2.98
R-JW-Y	Yellow	50 ft. roll	2.98
R-JW-R	Red	50 ft. roll	2.98

JUST WRAP™ Unwrap Tool $3.49

ok Vacuum Vise



Vacuum-based light-duty vise for small components and assemblies. ABS construction. 1½'' jaws, 1¼'' travel. Can be permanently installed.

VV-1 ...... $3.49

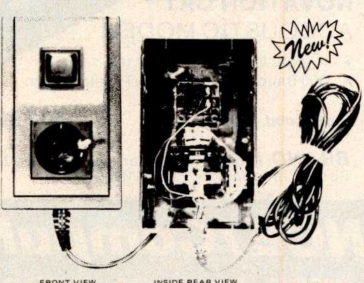
ADJUSTABLE WRENCH



- Two Sizes: 6'' and 10''
- Professional Quality
- Chrome Vanadium Steel

6''– AW-6 . . $4.95 10''– AW-10 . . $6.95

JOYSTICK VIDEO CONTROLLER



- IDEAL FOR ALL VIDEO GAMES OR REMOTE CONTROL PROJECTS
- SMALL CASE SIZE: 1-1/2''H x 2-3/8''W x 4-5/16''L
- 2 MINIATURE POTENTIOMETERS – 40K OHM EACH
- SPST PUSH BUTTON CONTROL
- 5-WIRE CONNECTION CABLE – 5 FEET LONG
- RUGGED PLASTIC CASE

JVC-40 ...... $4.95 each

BUY DIRECT FROM NCE/ CompuMart



Buy Direct from the Largest Commodore Dealer in the Country — NCE/CompuMart.

8K-Keyboard N	$795
16K-Keyboard B	$995
16K-Keyboard N	$995
32K-Keyboard B	$1,295
32K-Keyboard N	$1,295

B — large keyboard (graphics not on keys)
N — large keyboard with graphics symbols

SUPER SAVER. Thanks to Commodore their printer prices have been drastically reduced:

Commodore Printer (tractor feed) .... was $995 **NOW $795**
Commodore Printer (friction feed) .... was $849 **NOW $695**

2 Good reasons for buying your PET™ from CompuMart:

(1) $100 IN FREE ACCESSORIES WITH 16K or 32K PET.

When you buy a 16K or 32K PET, apply $100 toward PET accessories. FREE. Choose from the accessories listed below and indicate on your order that you have reduced the cost of your accessories by $100.

(2) FREE WITH PURCHASE OF ANY PET (Offer good until April 15, 1980)

A Texas Instruments' Hex/Octal Calculator ($60 Value), and a set of 6 PET Workbooks (Worth $36).

PET Accessories

Commodore Dual Floppy Disk Drive	$1,295.00
Second Cassette—from Commodore	$95.00
Commodore PET Service Kit	$30.00
Beeper—Tells when tape is loaded	$24.95
Petunia—Play music from PET	$29.95
Video Buffer—Attach another CRT	$29.95
Combo—Petunia abd Video Buffer	$49.95
TNW Bi-Dir.RS-232 printer S-face	$229.00
KIM 1 (A Single Board Computer from Commodore)	$179.00
PET TO IEEE Cable	$39.95
IEEE TO IEEE Cable	$49.95
KIM1 & Power Supply Package Special	$200.00



We have a complete inventory of Apple computers, peripherals, & software In-Stock for immediate delivery — Call us for prices.

$200 in FREE accessories with the purchase of a 48K Apple II reg. or Apple II plus.

16K Apple reg. or plus — $1,195 ($100 in *free* acces.)
32K Apple reg. or plus — $1,395 ($150 in *free* acces.)
48K Apple reg. or plus — $1,495 ($200 in *free* acces.)

Apple Accessories

PASCAL	$495
Micromodem	$379
VisiCalc	$150
The Controller (Business Package)	SALE! $550
The Cashier (POS System)	SALE! $200
Integer BASIC ROM Card	$200
Centronics Printer Interface	$225
Disk and Controller	$595
Parallel Printer Card	$180
Communications Card	$225
Hi-Speed Serial Card	$195
Firmware Card	$200
NEW! AppleWriter Text Editor	$75

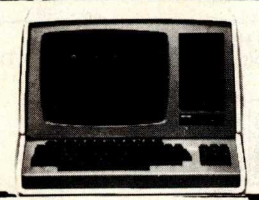
NEW FROM EXIDY THE SORCERER II 48K COMPUTER

Z-80 Microprocessor, Full-sized keyboard • ROM PAC Programs • Microsoft BASIC • Powerful Graphics • Serial and Parallel I/O • Dual Cassette I/O Memory Internally Expandable • S-100 Expansion Options.

48K Sorcerer II **$1,395**

ZENITH

The All-In-One Computer

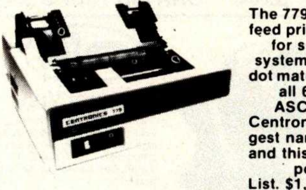


Save $300 off list on all Zenith Computers, $250 off the printer. Build a great system using both and save $550.

WH89 with 16K RAM	**list $2,295**	**SALE! $1,995**
WH89 with 32K RAM	**list $2,445**	**SALE! $2,145**
WH89 with 48K RAM	**list $2,595**	**SALE! $2,295**
Heath Printer	**list $895**	**SALE! $650**
16K Memory Expansion	**list $150**	**SALE! $110**
Dual-port Serial Interface		**$85**
HD05 Operating System		**$100**
Microsoft Basic		**$100**
WH17 Second Disk Drive		**$550**

Only limited quantities of the Computers and Printers are available. Order Now. (Offer good until April 15, 1980)

CENTRONICS PRINTERS



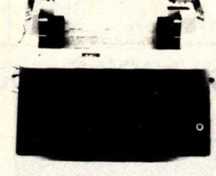
The 779-2 is a tractor feed printer designed for small business systems. Uses a 5x7 dot matrix to produce all 64 upper case ASCII characters. Centronics is the biggest name in printers and this is their most popular model.
List. $1,245 .... SALE! $1,079

The New 730-1 parallel matrix printer is ideally suited for all personal and microcomputer systems. Standard Features include: 100 cps • 80 char./line • 3-way paper handling system • 7x7 dot matrix • 96 character ASCII • List $995 .... SALE! $695

The Perfect Printer for Small Business Systems

The Paper Tiger Printer From ROAR! Integral Data

Standard features include: 4 character 8.3 to 16.5 cpi • 56 cps at 10 char. per in. • Selectable line spacing • 8 switch-selectable form sizes.



The IDS Graphics Option for the Paper Tiger allows full dot pattern control and includes an expanded 2048-byte buffer (a 256-byte buffer is standard).

IDS Paper Tiger Printer $995
IDS Graphics Paper Tiger Printer $1,094

SPECIAL OFFER EXCLUSIVE FROM COMPUMART!

ZENITH COLOR VIDEO MONITOR

Beautiful Display Capabilities. Excellent for use with Apple, Atari, & Sorcerer Computers. This 13-inch monitor is Zenith's first color video display designed specifically for computers. Features include color and degaussing circuits.

Zenith Color Monitor $499.00

HAZELTINE TERMINALS AT SPECTACULAR SAVINGS!

Hazeltine 1410-TTY-style keyboard, 8 baud rates from 110 to 9600, 12" screen, 24x80 display, 5x7 dot Matrix Upper Case ASCII character set, 12-key numeric keypad. List Price $895 ...... **SALE! $779**

Hazeltine 1500 — 8 baud rates from 110 to 19,200, and ANSI Standard Keyboard, EIA RS-232, All 94 Upper/Lower Case characters in a high resolution 7x10 matrix display. Much more.
List Price $1,145 .... **SALE! $995**

Hazeltine 1520 — Take advantage of this $310 savings while it lasts! The Hazeltine 1520 is a powerful multi-processor terminal.
List Price $1,585 .... **SALE! $1,275**

NOVATION CAT™
ACCOUSTIC MODEM

- Answer Originate
- Bell 108
- 300 Baud
- Low Profile Design

Looks good, works great! **$179.00**

BRAND NEW! The "Star" Modem from Livermore Special Introductory Price $158.00

SANYO MONITORS



9-inch reg. $199 **SALE! $169**

15-inch reg. $299 **SALE! $269**

Perfect for Apple users ...
Sanyo Cassette Recorder **$55**

NCE/CompuMart

We've Had a Reputation for Dependability Since 1971.

DEPT. BY4, 270 THIRD ST., CAMBRIDGE, MA. 02142

To Order: 1 (800) 343-5504
In Mass: 1 (617) 491-2700





Member Computer Dealers Assoc.

REMOTE TERMINAL FOR YOUR PET
Only $98

A self-contained module and program cassette enables your PET to function as a 300 baud terminal. Supports Upper/Lower case. Rubout, Escape and all control functions. Output is TTL. Can be used with THE SOURCE. You will need the Terminal Option, Cat Coupler & EIA Cable to do this. Complete package which includes all 3 available from CompuMart for $279.

Circle 209 on inquiry card.

10-DAY FREE TRIAL

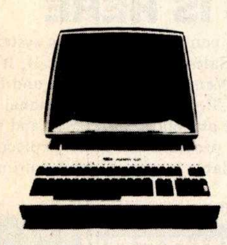
SEND FOR OUR FREE CATALOG

Lear Siegler Terminals & Printers At *Tremendous Savings*



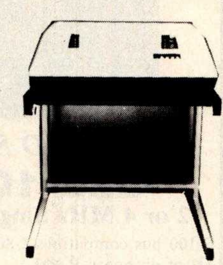
ADM-3A. Industries' favorite dumb terminal for some very smart reasons. 12" diagonal screen • Full or half duplex operation at 11 selectable data rates • 1,920 easy-to-read characters in 24 rows of 80 letters • RS-232C interface extension port • Direct cursor addressing. Reg. Price. $895 .... **Sale! $795**

ADM-31. A terminal that's too smart to be considered dumb. Comes complete with keyboard, control logic, character generator, refresh memory & interface • Displays two pages of text instead of one • Field protect mode • Factory installed selected parameters. Reg. Price. $1,450 .... **Sale! $1,195**



ADM-42. The semi-intelligent terminal that provides you with flexibility of format, security, editing, interface, and transmission. Two-page display standard (Optionally expandable to eight) • Blanking, blinking, and reverse fields • Three ways to TAB • 16 Function keys do the work of 32 • Detachable keyboard.

ADM-42 with Keyboard. Reg. Price. $1,795 **Sale! $1,595**
ADM-42 without keyboard. Reg. Price. $1,595 .... **Sale! $1,450**



300 Series Ballistic Printers. This application-oriented matrix printer is built to last. Features include: Ballistic Printing • Positive 180 cps • Bi-directional Printing • A character buffer that is optionally expandable to 2,048 characters • 512 character buffer standard.

Model 310 Ballistic Printer (Serial/Parallel) Reg. Price. $2,045 .... **Sale $1,989**

We Stock Lear Siegler Accessories — Call For Details.



6502 Microprocessor • 20-character, alpha-numeric LED display • Full-size 54-key keyboard with 3 user-defined functions • Fast, on-board 20-column thermal printer • 8K Advanced Interactive Monitor program • Dual cassette interface board • On-board timer • On-board ROM expansion to 12K • 4K on-board RAM • On-board TTY interface • 16 parallel 1/0 lines • One serial 1/0 port • KIM-compatible edge connectors for even further memory or 1/0 expansion.

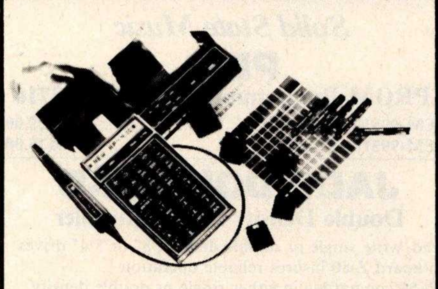
The CompuMart AIM System combines all of our options for the AIM to give you the capabilities of development systems costing 5 to 10 times as much. This system includes a 4K AIM 65 with BASIC and Assembler, an MTU power supply, a Sanyo tape recorder and an EGI Enclosure for the AIM.

CompuMart AIM System **$785.00**
4K AIM-65 .... **$450.00**
Paper for the AIM **$4.75**

WE'VE GOT IT!

A Calculator, A system, A Whole New Standard.

The finest calculators available for Science, Engineering, & Business.



HEWLETT-PACKARD'S HP-41C

HP-41C

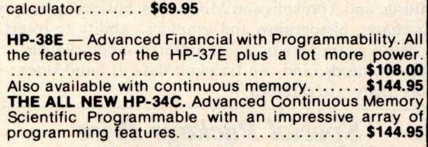
The Calculator.

Features over 130 functions and offers up to 400 lines of program memory or 63 data storage registers — expandable to 319 registers or up to 2,000 lines. RPN Logic. Alpha-numeric capabilities let you communicate with the calculator in English. Customization features allow you to totally reassign the keyboard functions. Continuous memory....... **HP-41C Calculator $288.00**

The System.

Memory Modules. For storing programs or up to 2,000 lines of program memory. **$45.00**
"Extra Smart" Card Reader. Records programs and data back onto blank mag-cards. **$179.00**
The Printer. Upper and Lower case. High resolution plotting. Portable. Thermal operation. **$320.00**
Application Modules.................. **$45.00 EACH.**
Standard pac, Statistics, Math, Financial, & Surveying.

HP SERIES E CALCULATORS



HP-31E — Scientific. Trigonometric, exponential & math functions. **$49.95**
HP-32E — Advanced Scientific with Statistics. All HP-31E functions plus hyperbolies and comprehensive statistics. **$66.95**
HP-33E — Programmable Scientific. A programmable science, math and statistical calculator. **$79.95**
Also available with continuous memory....**86.40**
HP-37E — Business Management. Best choice for a business/finance calculator........ **$69.95**

HP-38E — Advanced Financial with Programmability. All the features of the HP-37E plus a lot more power. **$108.00**
Also available with continuous memory....... **$144.95**
THE ALL NEW HP-34C. Advanced Continuous Memory Scientific Programmable with an impressive array of programming features. **$144.95**

CompuMart STOCKS THE COMPLETE LINE OF MATROX PRODUCTS. CALL FOR SPECS.

Based on our policy of offering our customers only the finest in microcomputers, CompuMart is pleased to announce that we now carry the new generation of Personal Computers by Atari.™



INTRODUCTORY SPECIALS

To celebrate our commitment to Atari, we are offering the following Atari Specials:
(1) Buy additional memory for your computer, 8K or 16K, and we will double the amount of memory FREE!
(A potential savings of $200.)
(2) Buy the Atari 800 Computer and take $100 off the purchase price of the Atari 810 Disk Drive or the Atari 820 printer.

ATARI® 800™

PERSONAL COMPUTER SYSTEM

Comes with:

- Computer Console
- BASIC Language Cartridge
- Education System Master Cartridge
- BASIC Language Programming Manual
- 800 Operator's Manual
- ATARI 410 Program Recorder
- Invitation to Programming™ Cassette
- 8K RAM Memory Module™
- 10K ROM Operating System
- Power Supply
- TV Switch Box

SPECIFICATIONS:

High resolution color graphics
57 key full stroke keyboard
Built-in RF modulator for channel 2/3 operation with standard TV set
Composite video output for use with monitor
Internal Speaker
Two cartridge slots for rapid program insertion
Four internal slots for expansion up to 48K RAM
6502B Microprocessor
High speed serial 1/0 port

Atari 800 Computer System $995.95

ATARI® 820™ PRINTER

High resolution dot matrix impact printer
Uses standard ⅜ inch roll paper and ribbon
40 characters per line
Speed: 40 characters per second
UL approved

Atari 920 Printer $599.95

ATARI® 810™ DISK DRIVE

Uses standard 5¼ inch diskettes
88K bytes storage per diskette
Up to four disk drive units can operate with the system
Average data access time: 236 milliseconds
Power: AC adapter; UL approved

Atari 810 Disk Drive $699.95

Upgrade your computer with additional memory. (Note that the Atari 800 Computer comes with 8K of RAM memory and will accept up to 48K.)

Atari 8K RAM Memory Module $124.95
Atari 16K RAM Memory Module $199.95

NCE/CompuMart

Dept. BY4,
270 Third St.,
Cambridge, Mass.
02142

TO ORDER CALL:
1-800-343-5504
IN MASS. CALL: (617) 491-2700

IMPORTANT ORDERING INFORMATION

All orders must include 4% shipping and handling. Mass. residents add 5% sales tax; Mich. residents 4%, for sales tax.

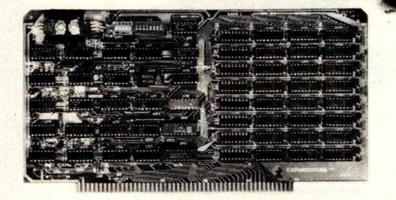
Phones open from 8:30 a.m. to 5:30 p.m. EST, Mon.-Fri. • P.O.'s accepted from D&B rated companies – shipment contingent upon receipt of signed purchase order • All prices are subject to change without notice • Most items in stock for immediate shipment – call for delivery quotation • In the Ann Arbor area? Our retail store is open 11:00 a.m. to 7:00 p.m. Tues.-Fri., 10:00 a.m. to 5:00 p.m. Saturdays (closed Sun. and Mon.)

***IF NOT SATISFIED RETURN PURCHASE WITHIN 10 DAYS FOR A FULL REFUND.**

Circle 209 on inquiry card.

JADE. INFLATI FOR THE 80's.

JUDGE'S CHOICES



EXPANDORAM

Expandable to 64K Using 4116 RAMS

Interfaces with most popular S-100 boards
Bank selectable; PHANTOM provision
Draws only 5 watts fully populated
Designed to work with Z-80, 8080, and 8085 systems
No wait states required
16K boundaries & protect via dip switches
Kits come with sockets for full 64K
Invisible refresh

MEM-16130K (16K KIT)	**$239.95**
MEM-16130A (16K A&T)	**$289.95**
MEM-32131K (32K KIT)	**$309.95**
MEM-32131A (32K A&T)	**$359.95**
MEM-48132K (48K KIT)	**$379.95**
MEM-48132A (48K A&T)	**$429.95**
MEM-64133K (64K KIT)	**$449.95**
MEM-64133A (64K A&T)	**$499.95**

Call For Sale Prices !

32K STATIC RAM

Expandable 8K/32K, 2/4MHz, KIT/A&T

Switchable 2 or 4 MHz

THE JADE BIG Z

Z-80A CPU with Serial I/O Port

This CPU can accomodate a 2708, 2716, or 2732 EPROM in SHADOW mode, allowing you to use a full 64K or RAM. The MWRITE signal is generated automatically if you use the board without a front panel. There's also an independent on-board USART to control the RS232 serial port at baud rates from 75 to 19,200.

We've sold thousands of these high quality S-100 CPU boards at $159.95; **but now,** in a brief fit of financial insanity, we're offering them to you for only $135.00! **Don't pass this one up!**

CPU-30201K (KIT)	**$135.00**
CPU-30201A (A&T)	**$199.00**
CPU-30200B (BARE BOARD)	**$35.00**

S D Systems

EXPANDORAM II

4 MHz RAM Board Expandable to 256K

S-100 bus compatible, up to **4 MHz** operation
Expandable memory from 16K to 256K
Dip switch selectable boundaries
Page-mode allows up to 8 boards on the same bus
Invisible refresh; PHANTOM output disable
Designed to operate in Z-80 based systems

MEM-16631K (16K KIT)	**$295.95**
MEM-16631A (16K A&T)	**$345.95**
MEM-32632K (32K KIT)	**$369.95**
MEM-32632A (32K A&T)	**$419.95**
MEM-48632K (48K KIT)	**$444.95**
MEM-48632A (48K A&T)	**$494.95**
MEM-64632K (64K KIT)	**$519.95**
MEM-64632A (64K A&T)	**$569.95**

Solid State Music

PB-1

EPROM Programmer for 2708 or 2716

MEM-99510K (KIT)	**$125.00**
MEM-99510A (A&T)	**$175.00**

JADE DOUBLE-D

Double Density Disk Controller

Read/write single or **double density,** 8″ or 5¼″ drives
On board Z-80 insures reliable operation
CP/M compatible in either single or double density
Density is software selectable
Up to 4 single or double sided, single or double density drives may be mixed on the same system
EIA level serial printer interface on board-up to 9600 baud (perfect for despooling operations)
All the hard work of disk access is done by the on board Z-80A and 2K memory, leaving your host CPU free for its normal duties
Uses IBM standard formats for proven reliability
THIS BOARD REALLY WORKS!!!!!!

IOD-1200K (DOUBLE-D KIT)	**$285.00**
IOD-1200A (DOUBLE-D A&T)	**$349.00**
IOD-1200D (MANUAL ONLY)	**$15.00**

Terminal Sale

ADDS REGENT

Our Finest Line of Terminals

REGENT 20 $795.00

24 lines X 80 characters, EIA and 20ma current loop interfaces, 110 to 9600 baud, 96 ASCII codes plus 32 control codes, both upper and lower case, 8 X 8 dot matrix, reverse video, auxiliary EIA serial interface, and addressable cursor.

REGENT 25 $850.00

All the features of the Regent 20 plus an 18 key numeric and cursor control pad.

REGENT 40 $1195.00

All the features of the Regent 20 plus a 14 key numeric pad, 8 function keys, 5 cursor control keys, auxiliary port control key, reverse video, underline, blinking, plus full, half, and zero intensities, 8 X 8 dot matrix, 11 special line drawing symbols, reverse scrolling, and send/receive capability using the Regent 40's bi-directional interface.

REGENT 60 $1495.00

All the features of the Regent 40 plus Print Local, Editing, and Transmission Mode keys, business graphics, bar charts, histograms, and graphics, ability to insert or delete characters or lines, buffered mode reduces software needs, and can transmit data at baud rates other than rate received.

Special Package Price

RS-232 SET-$6.50

1 Male DB-25, 1 Female DB-25, 1 Cover

JADE DISKETTES

Magnificent Magnetic Media™

5¼″ single sided, single density, box of 10

MMD-5110103 (SOFT SECTOR)	**$29.95**
MMD-5111003 (10 SECTOR)	**$29.95**
MMD-5111603 (16 SECTOR)	**$29.95**

5¼″ double sided, double density, box of 10

MMD-5220103 (SOFT SECTOR)	**$39.95**

8″ single sided, single density, box of 10

MMD-8110103 (SOFT SECTOR)	**$34.95**

8″ single sided, double density, box of 10

MMD-8120103 (SOFT SECTOR)	**$55.95**

8″ double sided, double density, box of 10

MMD-8220103 (SOFT SECTOR)	**$57.95**

S D Systems

VERSAFLOPPY

Versatile Floppy Disk Controller

IBM 3740 soft sectored format
S-100 Z-80 or 8080 compatible
Controls up to 4 single or double sided drives
Compatible with all popular disk drives
CP/M compatible
Listings for control software included

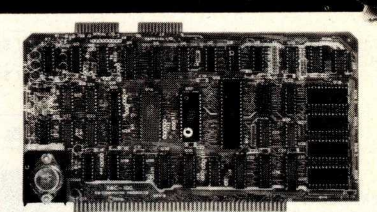
IOD-1150K (KIT)	**$239.00**
IOD-1150A (A&T)	**$289.00**

New Disk Operating System

SDOS IS HERE

SDOS is a CP/M compatible operating system designed for the S.D. Sales Versafloppy I or II. It requires the SBC-100/Versafloppy board set and functions as a superset of CP/M, giving 19 additional functions including file attributes, disk label, and read/write logical blocks. It provides additional protection features, and is expandable to a multi-user real-time system.
SDOS sells for $200.00

BELLRINGERS



S D Systems

SBC-100/200

2 or 4 MHz Single Board Computer

S-100 bus compatible Z-80 CPU
1K of on-board RAM
4 EPROM sockets accomodates 2708, 2716, or 2732
One parallel and one serial I/O port
4-channel counter timer chip (Z-80 CTC)
Software programmable serial baud rates

CPC-30100K (2 MHz KIT)	**$249.95**
CPC-30100A (2 MHz A&T)	**$299.95**
CPC-30200K (4 MHz KIT)	**$289.95**
CPC-30200A (4 MHz A&T)	**$339.95**

Coming Soon

NEW JADE P/S I/O

Parallel Serial Interrupt Board

Z-80 SIO, PIO, 2 CTCs, expands to 2 SIOs, 4 CTCs
4 serial ports (async, sync, bisync, SDLC/HDLC)
2 parallel ports **with full handshake**
Software baud rate generators, interval timers, counters, and generates 32 vectored interrupts
Designed especially for MP/M multi-user multi-tasking operating systems. For use with Z-80 only

IOI-1045B (BARE BOARD)	**$55.00**
IOI-1045K (KIT)	**$169.95**
IOI-1045A (A&T)	**$224.95**

Solid State Music

I/O-4

2 Serial & 2 Parallel I/O Ports

IOI-1010K (KIT)	**$149.95**
IOI-1010A (A&T)	**$199.95**

Circle 210 on inquiry card.

ON FIGHTER ROUND #1.

KNOCKOUT PRICES

S D Systems

VERSAFLOPPY II

Double Density Disk Controller

Single or double density floppy disk controller
985600 bytes on 8″ double sided diskettes
259840 bytes on double sided 5¼″ diskettes
S-100 bus (IEEE) standard compatible
IBM 3740 format in single density
8″ and 5¼″ drives controlled simultaneously
Operates with Z-80, 8080, and 8085 CPU's
Controls up to 4 drives
Vectored interrupt operation optional

IOD-1160K (KIT) **$335.95**
IOD-1169A (A&T) **$385.95**

HEAVYWEIGHTS

ATARI 800

Don't Miss Out on Our Special Sale Price

At last there is a machine designed to give serious competition to Apple and Radio Shack. This computer contains many advanced technical features such as: built in RF modulator for use with a standard TV; 8K of internal RAM (expandable to 48K), 8K BASIC language included; extremely sharp high-resolution color graphics; and built-in peripheral I/O ports. Software is available in plug-in paks and cassette tapes, with many programs available in the areas of entertainment, education, and business/home management.

Available accessories include a printer, disk drives, game controller paddles, and memory expansion cartridges.

And JADE has the Atari 800 **in stock** at a special introductory price.

ATARI 800 .... **$950.00**
810 DISK DRIVE **$699.95**
820 PRINTER **$599.95**
16K RAM EXPANSION KIT **$199.95**
CX30-04 PADDLE CONTROLLER **$19.95**
CX40-04 JOYSTICK CONTROLLER **$19.95**
ATARI 400 .... **$599.95**

Vector Graphic's

HI-RES GRAPHICS

256X240 S-100 Hi—Res Graphics Board

IOV-1070K (KIT) **$150.00**
IOV-1070A (A&T) **$199.95**

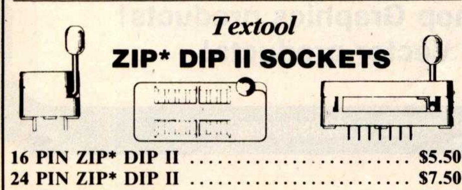
Limited to Stock on Hand

SPST DIP SWITCHES

Part #	Pos.	Price			
SWD-103	3	$1.00	SWD-107	7	$1.20
SWD-104	4	$1.05	SWD-108	8	$1.25
SWD-105	5	$1.10	SWD-109	9	$1.30
SWD-106	6	$1.15	SWD-110	10	$1.55

Textool

ZIP* DIP II SOCKETS



16 PIN ZIP* DIP II **$5.50**
24 PIN ZIP* DIP II **$7.50**
40 PIN ZIP* DIP II **10.25**

*** ZERO INSERTION PRESSURE**

CHAMP'S PRIZES

RAMS	
21L02 (2 MHz)	$1.25
21L02 (4 MHz)	$1.50
2114L (2 MHz)	$5.75
2114L (4 MHz)	$5.95
4116 (250ns)	$8.95
4116 (200ns)	$9.50
4127 (70ns)	$39.95
4164 (64K x 1)	$175.00
5257 (2 MHz)	$6.75
5257 (4 MHz)	$7.25
BAUD RATE GENERATORS	
MC14411	$10.00
CRYSTAL	$4.95

SUPPORT DEVICES	
8212	$2.50
8214	$4.65
8216	$2.95
8224	$3.25
8226	$3.85
8228	$4.95
8238	$4.95
8243	$8.00
8250	$14.95
8251	$6.50
8253	$13.95
8255	$6.50
8257	$19.95
8259	$17.95
8275	$49.95
8279	$8.95
3881	$12.95
3882	$12.95
3883	$45.00

6800 SUPPORT	
6821P	$5.95
6828P	$11.95
6834P	$12.95
6840P	$18.75
6850P	$4.80
6852P	$5.79
6875L	$7.40
68488P	$25.00

PROMS	
2708 (450ns)	$8.95
2716 (450ns)	$34.95
2716 (5v)	$34.95
2732 (5v)	$95.00
2758 (5v)	$34.95

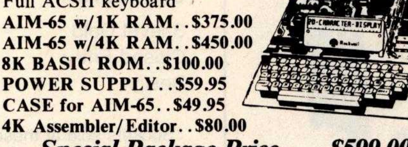
MICROPROCESSORS	
Z-80	$10.95
Z-80A	$12.50
6502	$11.50
6800	$11.95
6802	$17.95
6809	$39.95
8035	$24.00
8035-8	$24.00
8080A	$6.59
8085	$15.95
TMS9900JL	$39.95

UARTS	
AY5-1013A	$5.25
AY3-1014A	$8.25
TR1602B	$5.25
TMS6011	$5.95
IM6403	$9.00

Special Package Price

ROCKWELL AIM-65

The Head-Start in Microcomputers



KIM-1 compatible
On-board printer
Full ACSII keyboard
AIM-65 w/1K RAM..$375.00
AIM-65 w/4K RAM..$450.00
8K BASIC ROM..$100.00
POWER SUPPLY..$59.95
CASE for AIM-65..$49.95
4K Assembler/Editor..$80.00

Special Package Price ***$599.00***

4K AIM-65, 8K BASIC ROM, Power Supply, and Case.

JADE
Memory Expansion Kits
FOR

TRS-80 APPLE EXIDY

Everything you need to add 16K of memory to your computer. Your kit comes neatly packaged with easy to follow instructions. In just minutes your computer is ready to tackle more advanced software.

$65.00

Integral Data Systems

THE PAPER TIGER

132 Column Dot Matrix Printer



Up to 198 CPS
1.75 to 9.5 inch adjustable tractor.
Parallel and serial interface.
98 character ASCII set.
80 to 132 columns.
6 or 8 lines per inch.
Eight software selectable character sizes.
110, 300, 600, or 1200 baud.

PRM-33440 .... **$950.00**
PRM-33441 (GRAPHICS & 2K BUFFER) . **$1050.00**

CP/M 2.0

Digital Research has done it again! This new release of their industry standard disk operating system is bound to be an even bigger hit than the original version. All of the fundamental file-size restrictions of release 1 have been eliminated, while maintaining full compatability with the earlier versions. This new release can be field-configured by the user for a single mini-disk up through a multiple drive hard-disk system with 128 megabyte capacity. Field configuration can be accomplished easily through use of the Macro Library (DISKDEF) provided with CP/M 2.0.

A powerful operating system for only **$150.00**

Jade's New Motherboards

THE ISO-BUS

6-SLOT

BARE BOARD **$24.95**
KIT **$49.95**
ASSEMBLED & TESTED **$59.95**

12-SLOT

BARE BOARD **$39.95**
KIT **$89.95**
ASSEMBLED & TESTED **$99.95**

18-SLOT

BARE BOARD **$59.95**
KIT **$129.95**
ASSEMBLED & TESTED **$149.95**

Special Price for

NOVATION CAT

Acoustic Coupler/Modem

$157.50



Let your computer talk to other computers!
Bell Systems 103 compatible
300 baud, answer or orginate

IOM-5200A (SALE PRICED) **$157.50**

PLACE ORDERS TOLL FREE

Inside California	Continental U.S.
800-262-1710	**800-421-5500**

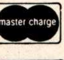
Write for our FREE 1980 catalog

For customer service or technical inquiries call
213-973-7707

TERMS OF SALE: Cash, checks, money orders and credit cards accepted. Minimum order $10.00. California residents add 6% sales tax. Minimum shipping and handling charge $2.50. Prices are for U.S. and Canadian delivery only and are subject to change without notice. For export prices and information send for a **JADE INTERNATIONAL CATALOG.**







JADE

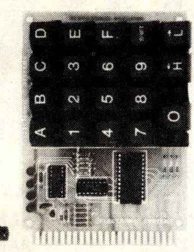
COMPUTER PRODUCTS

4901 W. Rosecrans, Hawthorne, CA 90250

Circle 210 on inquiry card.

HEX ENCODED KEYBOARD

Four onboard LEDs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX- 3A. 44 pin edge connector $4.00 Part No. 44P.



ASCII TO CORRESPONDENCE CODE CONVERTER

This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $249.95. Part No. TA 1000C

ASCII KEYBOARD

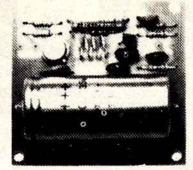
53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $119.95.



T.V. INTERFACE



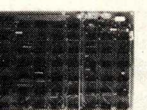
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple • Power required is 12 volts AC C.T., or +5 volts DC • Board only $7.60 part No. 107, with parts $13.50 Part No. 107A

TAPE INTERFACE



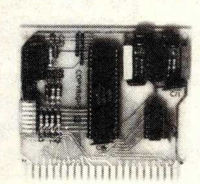
• Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $29.95 Part No. 111A

T.V. TYPEWRITER



• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A

UART & BAUD RATE GENERATOR



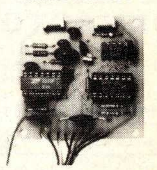
• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P

SOROC IQ 120



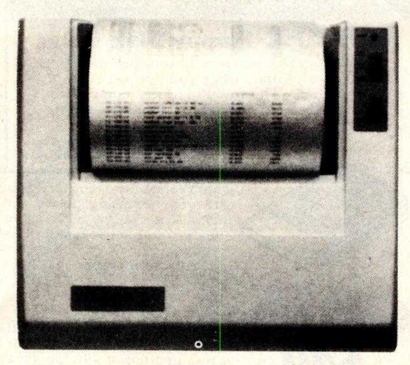
Upper/lower case display • Numeric keypad & cursor keys • Protected fields, ½ intensity display • RS 232 interface & aux. port. IQ120—$799.95 • IQ140 Detachable keyboard—$1199.95

MODEM



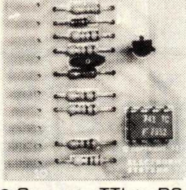
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • Serial TTL input and output • connect 8 Ω speaker and crystal mic. directly to board • Requires +5 volts • Board only $7.60 Part No. 109, with parts $29.95 Part No. 109A.

COMPRINT PRINTER



Printing Characteristics: 225 characters/second (170 lines/minute) throughput • 9 horizontal x 12 vertical matrix • 96 ASCII character set with upper and true lower case • 80 characters/line • 5.8 lines/inch
Buffer Memory: standard 256 bytes; • optional; 2,048 bytes (buffer memory option designated as Model 912-2K), add $149.95.
Paper Requirements: electrosensitive type (aluminum coated) • 8-1/2 inch width • 3.7 inch max. (300 ft.) roll diameter.
Model 912-S Interfacing: serial interface RS232 and 20 mA current loop • BAUD rates 110, 150, 300, 600, 1200, 2400 and 4800 are strap selectable.
Model 912-P Interfacing: parallel interface, IEEE-488 and 8 bit parallel (strobe/ acknowledge). Model 912-S, Part No. CPIA, 32118, $579.95. Model 912-P, Part No. CPIA, 32117, $559.95.

RS-32/TTL INTERFACE



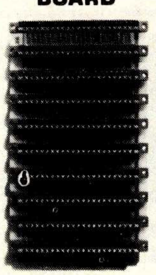
• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin edge connector, kit $9.95 Part No. 232A 10 Pin edge connector $3.00 part No. 10P.

COMPUCOLOR II



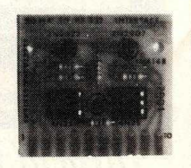
With reg. keyboard
MOD3 8K $1595.95
MOD4 16K $1695.95
MOD5 32K $1995.95
Now includes $250 more, worth of software and accessories with 101 key option add $134.95 with 117 key option add $179.95

44 BUS MOTHER BOARD



Has provisions for ten 44 pin (.156) connectors, spaced 3/4 of an inch apart. Pin 20 is connected to X, and 22 is connected to Z for power and ground. All the other pins are connected in parallel. This board also has provisions for bypass capacitors. Board cost $15.00 Part No. 102. Connectors $3.00 each Part No. 44WP.

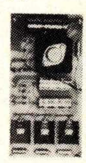
RS-232/20mA INTERFACE



This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.

DC POWER SUPPLY

• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A



To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U.S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800



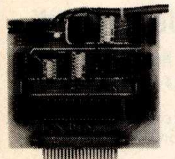
Send for FREE Catalog . . . a big self-addressed envelope with 41¢ postage gets it fastest!

ELECTRONIC SYSTEMS Dept. B P. O. Box 21638, San Jose, CA USA 95151

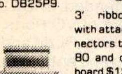
Circle 213 on inquiry card.

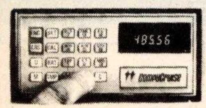
TRS-80 SERIAL I/O

• Can input into basic • Can use LLIST and LPRINT to output, or output continuously • RS-232 compatible • Can be used with or without the expansion bus • On board switch selectable baud rates of 110, 150, 300, 600, 1200, 2400, parity or no parity odd or even, 5 to 8 data bits, and 1 or 2 stop bits. D.T.R. line • Requires +5, -12 VDC • Board only $19.95 Part No. 8010, with parts $59.95 Part No. 8010A, assembled $79.95 Part No. 8010 C. No connectors provided, see below.



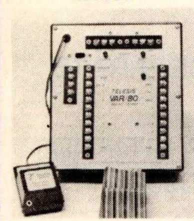
EIA/RS-232 connector Part No. DB25P $6.00, with 9', 8 conductor cable $10.95 Part No. DB25P9.





3' ribbon cable with attached connectors to fit TRS-80 and our serial board $19.95 Part No. 3CAB40.

COMPUCRUISE



$129.95; with cruise control $169.95

THE TELESIS VAR-80 INTERFACE UNIT

For the TRS-80 with Level II Basic • Provides 8 outputs • Provides 8 inputs • 2 ft. of interconnecting cable w/connector • Plugs directly into TRS-80 • Power supply provided • Assembled and tested. Part No. VAR80, Introductory price $109.95.

GAME PADDLES & SOUND



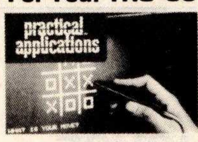
Includes: 2 game paddles, interface, software, speaker, power supply, full documentation including: schematics, theory of operation, and user guide; plus 2 games on cassette (Pong and Starship War). $79.95 Complete Part No. 7922C

DIGICOM DATA PRODUCTS INC. Series 312 Acoustic Coupler



300 BAUD Originate, Part No. AC3122, $219.95. 300 BAUD Answer, Part No. AC3122, $219.95. 300 BAUD Answer/Originate, Part No. AC3123, $229.95.

LIGHT-PEN For Your TRS-80



Your TRS-80 Light-Pen is a carefully engineered instrument and with the proper care will give satisfactory use and many years of service. Part No. TRS80LP $24.95.

SYSTEM EXPANSION from LNW Research

• Serial RS232C/20 mA I/O • Floppy controller • 32K bytes memory • Parallel printer port • Dual cassette port • Real-time clock • Screen printer bus • Onboard power supply • Software compatible • Solder mask, silk screen. PC board and user manual, Part No. LNW80, $69.95.

DISKETTES

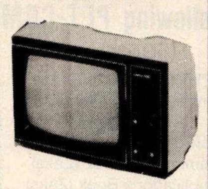


Box of 10, 5" $29.95, 8" $39.95.
Plastic box, holds 10 diskettes, 5" - $4.50, 8" - $6.50.

16K RAMS

For the Apple, TRS-80 or Pet $8 each Part No. 4116/2117.

LEEDEX MONITOR



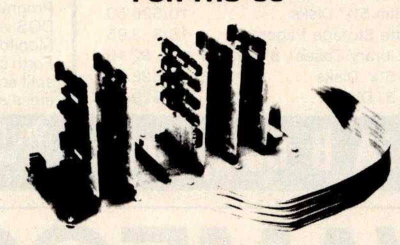
12" Black and White • 12 MHz Bandwidth • Handsome Plastic Case • $139.00

S-100 INTERFACE



AN S-100 bus Adapter—Motherboard for the TRS-80. Kit, Part No. HUH81DLXK, $295.95. Assembeled, Part No. HUH81DLXA, $375.95.

NOW! A FULL SUPPORT SYSTEM FOR TRS-80

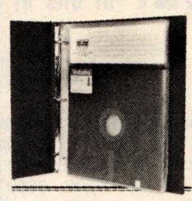


• 32K of RAM • EPROM firmware • Disk control • Data acquisition • Parallel I/O • Serial I/O • Plug into GPA's Motherboard. GPA's quality design includes • 6-44 pin edge connectors • +5V, -5V, +12V, -12V external power supply required • Active termination. The Motherboard, Part No. GPA80, is only $149.95.

TAKE ADVANTAGE OF GPA-EXPANSION CARDS FOR THE GPA80

Memory cards: Now with Fortran compilers available for your TRS-80, additional expansion memory is a must! Card with sockets only, Part No. GPA801, $119.95. Card with 16K of 4116 Dynamic Ram, Part No. GPA802, $224.95. Card with 32K of 4116 Dynamic Ram, Part No. GPA803, $329.95. All cards come equipped with sockets to accomodate 32K of Ram. **EPROM firmware card.** Put those valuable subroutines in firmware. Don't waste time loading and unloading tapes and disks. For 2708 or 2716 EPROMS, Part No. GPA806, $79.95. **Serial I/O card.** Here's what you've been asking for, a full serial terminal interface, with RS-232C or 20 mA. Current loop. Input/output capabilities. Part No. GPA807, $79.95. **Parallel I/O Card.** Control functions in the outside world, monitor and store real time events. Two parallel output ports. Dip switches select ports (0-254). Part No. GPA808, $79.95.

FLOPPY DISK STORAGE BINDER



Three-ring binder comes with ten transparent plastic sleeves which accommodate either twenty, five-inch or ten, eight-inch floppy disks. Binder & 10 holders $14.95 Part No. 8800; Extra holders 95¢ each. Part No. 800.

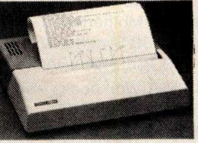
DIGITAL CASSETTE

5 min. each side. Box of 10 $9.95. Part No. C-5.

DISK JACKET™

Holds two 5-1/4 inch diskettes and will fit any standard three ring binder. $9.95/10 Pack.

TRENDCOM PRINTER



• 40 characters per second • 4-7/16 inch wide thermal paper • Graphics (TRENDCOM 100): 480 sevendot print postions per line. TRENDCOM 100, Part No. TRC0100, $495.95. TRENDCOM 200, Part No. TRC0200, $375.95. **Interface** for TRS-80, Part No. T80A $45.95. For Apple II, Part No. TRCAII, $75.95. For PET, NO. TRCP2, $79.95. For Scoccerer, TRCSR1 $45.95.

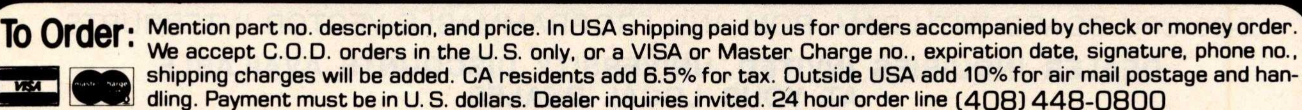
SARGON: A Computer Chess Program

Features the complete program that won the 1978 West Coast Computer Faire Tournament. Part No. 00603 — TRS-80 Level II; Part No. 00604 — Apple II (24K). $19.95

SOUND EFFECTS AND MUSIC FOR YOUR COMPUTER



SOUNDWARE is a complete system. It includes a speaker/amplifier unit with volume control, earphone jack, and connectors. It boasts excellent tone quality yet is small and convenient to use. Add batteries, plug it in, and play. One year warranty. SOUNDWARE package (includes INTRO to SOUNDWARE programs) PET (8K), Part No. 20003, $29.95. TRS-80 Level II (16K), Part No. 20002, $29.95. Compucolor II (8K), Part No. 20001, $39.95. INTRO to SOUNDWARE programs only PET and TRS-80, Part No. 20005, $14.95. Compucolor II Part No. 20006, $19.95.



To Order: Mention part no. description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders in the U. S. only, or a VISA or Master Charge no., expiration date, signature, phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 10% for air mail postage and handling. Payment must be in U. S. dollars. Dealer inquiries invited. 24 hour order line (408) 448-0800

Send for FREE Catalog . . . a big self-addressed envelope with 41¢ postage gets it fastest!

ELECTRONIC SYSTEMS Dept. B   P. O. Box 21638, San Jose, CA USA 95151

Circle 213 on inquiry card.

Circle 214 on inquiry card.



FREE! Up to $170 in merchandise with purchase of one of following PET-CBM items ! ! !

Axiom EX-801 PET Printer (with graphics)	$ 475.00
Axiom EX-820 PET Plotter	$ 749.00
Anderson Jacobson 841 Selectric	$1015.00
Leedex Video 100 12" Monitor	$ 119.00
Heath WH19 Terminal (factory asm.)	$ 770.00
Heath WH14 Printer (factory asm.)	$ 735.00
IEEE-RS 232 Printer Adaptor for PET	$ 88.00

BETSI PET to S-100 Interface	$ 119.00
PET Connectors-Parallel or IEEE	$ 1.95
Cassette Port	$ 1.45
Hands on Basic with a PET	$ 10.15
Programming the 6502 (Zaks)	$ 9.45
6502 Applications Book (Zaks)	$ 10.45
6500 Manuals (MOS Technology)	$ 6.50
Programming a Microcomputer: 6502	$ 8.45
6502 Assembly Language (Osborne) NEW!	$ 9.90

PET SPECIALS

		*FREE
PET 16N 16K full size graphics keyboard	$ 995	$130
PET 16B 16K full size business keyboard	$ 995	$130
PET 32N 32K full size graphics keyboard	$1295	$170
PET 32B 32K full size business keyboard	$1295	$170
PET 8N 8K full size graphics keyboard	$ 795	$100
PET 2040 DUAL DISK DRIVE-343,000 bytes	$1295	$170
PET 2022 Tractor Feed Printer	$ 795	$100
PET 2023 Pressure Feed Printer	$ 695	$ 70
PET C2N External Cassette Deck	$ 95	$ 12
Used 8K PETs (limited quantities)	$ 495	

★ **EDUCATIONAL DISCOUNTS** ★
Buy 2 PET Computers, get 1 FREE

*Free Merchandise with Purchase of PET-CBM Item.

KIM-1 $159 (add $30 for power supply) SYM-1	$209
BAS-1 Microsoft ROM Basic for SYM	$ 85
Memory Plus (KIM, SYM, AIM)	$195
SYM Assembler in ROM	$ 85
SEA-16 New 16K Static RAM	$325
Seawell Motherboard – 4K RAM Space	$139
KTM-2/80 Synertek Video Board	$349
S-100 16K Static RAM Kit **SALE**	$219
TIS PET Workbooks – set of 6	$ 21.50
Dust Cover for PET	$ 8.90

All Book and Software Prices are Discounted

PET Personal Computer Guide (Osborne)	$ 12.75
PET and the IEEE-488 Bus (Osborne)	$ 12.75
6502 Software Cookbook (Scelbi)	$ 9.45

Cassettes (all tapes guaranteed) AGFA PE611 Premium quality, high out put lownoise in 5 screw housing with labels:

C-10	10/5.65	50/25.00	100/48.00
C-30	10/6.90	50/30.00	100/57.00

2716 EPROM (5 volt) .... $ 29.00
6550 RAM (for 8K PET) .... $ 12.70
6502 $9.75 6522 $9.00 6520 $5.50
2114 L 450 ns $5.35 24@ $4.95 100 @ $4.45

MINIMAX by COMPU/THINK

MINIMAX I (.8 Megabyte Disks) $4495
MINIMAX II (2.4 Megabyte Disks) $5995

SPECIAL—MINIMAX prices include Compu/Think PAGEMATE Database and Report Writer at no charge.

The most advanced complete microcomputer system available. Includes CPU, 12" CRT, Full Keyboard, 2 Quad-Density Disk Drives, 2 Megahertz 6502 Hybrid Processor (double speed), 108 K System Memory, High Resolution (512 x 240) Graphics, Programmable Character Fonts, Microsoft Extended BASIC, DOS with Random Access I/O, Full Complement of I/O Ports, Monitor with Debug, Trace, and Tiny Assembler, Fifth (PL/M and Forth combination) Interpreter, Complete editing and entry with split screen capability, 64 Microprogrammable Opcodes, Business software (with Database) available.

ATARI – INTRODUCTORY SPECIAL

ATARI 400, Atari 800 and all Atari Modules 20% OFF.

Programmers Toolkit – PET ROM Utilities	$ 44.90
Sargon II (TRS-80 or Apple) NEW!	$ 24.90
Microchess for PET (Peter Jennings)	$ 17.90
Visible Music Monitor (4 Voice) for PET	$ 29.90
KL-4M 4 Voice Music Board (PET)	$ 34.90
CmC Word Processor (8K $25) (16K $34)	
Adventures by Scott Adams	15% Off

SALE

(write for quantity prices)

Scotch 8" Disks	10/$31.00
Scotch 5¼" Disks	10/$31.50
Verbatim 5¼" Disks	10/$26.50
Diskette Storage Pages	10/$ 3.95
Disk Library Cases 8" - $2.95	5" - $2.15
BASF 5¼" Disks	10/$28.00
BASF 8" Disks	10/$29.00

115 E. Stump Road
Montgomeryville, PA 18936
(215) 699-8386
699-5826

A B Computers

WRITE FOR COMPLETE CATALOG
Add $1.00 per order for shipping.
We pay balance of UPS surface charges on all prepaid orders.

WAMECO

THE COMPLETE PC BOARD HOUSE
EVERYTHING FOR THE S-100 BUSS

INTRODUCTORY SPECIAL
IOB-1 SERIAL/PARALLEL INTERFACE BOARD

* TWO PARALLEL DATA PORTS PROGRAMMABLE USING AN 8255 WITH SEPARATE HANDSHAKING.
* ONE SERIAL PORT USING AN 8251 WITH PROVISIONS FOR PARITY, STOP BIT AND CHARACTER LENGTH. BAUD RATES 110 TO 9600 BAUD. OUTPUTS RS232, TTL AND CURRENT LOOP.
* KANSAS CITY STANDARD CASSETTE INTERFACE, 300 BAUD FOR USE WITH THE SERIAL INTERFACE.
* STATUS MAY BE POLLING SOFTWARE OR VECTURED INTERRUPTS.
PCBD $31.95
KIT TO BE ANNOUNCED LATER.

FUTURE PRODUCTS: 80 CHARACTER VIDEO BOARD.
Z-80 CPU BOARD WITH RAM, ROM AND PROGRAMMABLE VECTOR INTERRUPTS.

DEALER INQUIRIES INVITED, UNIVERSITY DISCOUNTS AVAILABLE AT YOUR LOCAL DEALER

MOST PRODUCTS FOR IMMEDIATE SHIPMENT. NO 4-8 WEEK DELAYS REQUIRED FOR OTHERS.



NOTE: NEW ADDRESS AND PHONE

WAMECO, INC., P. O. BOX 877 • 455 PLAZA ALHAMBRA • EL GRANADA, CA 94018 • (415) 726-6378

Circle 215 on inquiry card.

Radio Hut Radio Hut Radio Hut Radio Hut

Radio Hut

201 LOCHWOOD MALL • DALLAS, TEXAS 75218
ORDER BY PHONE—214-324-5509

PLEASE WRITE FOR CATALOG
PRICES SUBJECT TO CHANGE
WITHOUT NOTICE

ORDERING INFORMATION & TERMS: Orders under $15.00 add 75¢ handling. No C.O.D. We accept Visa, MasterCharge, and American Express cards. Tex. Res. add 5% tax. Foreign orders (except Canada) add 20% P&H. 90 Day Money Back Guarantee on all items. Add 5% P&H, maximum $5.00.
ORDER BY PHONE — (214) 324-5509

SD EXPANDORAM

The EXPANDORAM is available in versions from 16K up to 64K, so for a minimum investment you can have a memory system that will grow with your needs. This is a dynamic memory with the invisible on-board refresh, and IT WORKS!

- Bank Selectable
- Phantom
- Power 8VDC, +16VDC, 5 Watts
- Lowest Cost Per Bit
- Uses Major Brand 16K RAMS
- PC Board is doubled solder masked and has silk-screened parts layout
- Extensive documentation clearly written

- Complete kit includes all Sockets for 64K
- Memory access time: 375ns, Cycle time: 500ns.
- No wait states required
- 16K boundaries and Protection, via Dip Switches
- Designed to work with Z-80, 8080, 8085 CPU's

EXPANDORAM 64K Kit (16K Ram)

16K	$239.95
32K	309.95
48K	379.95
64K	449.95

SD'S PROM 100 PROM Programmer Board

The PROM-100 Programmer is a development tool for S-100 Bus computer systems. The Zero Insertion Force Programming Socket extends above the card cage height for easy access to PROM devices. Software verifies PROM erasure, verifies program loading and provides for reading of object file from Disk or PROM and programming into PROM/EPROM. Features include: On-board generated 25vdc Programming pulse, TTL compatible, maximum programming time for 16,389 bits is 100 seconds. Programs: 2708, Intel 2758, 2716, 2732 and TI 2516. DIP Selectable EPROM type.

PROM-100 Board Kit $149.95

SD'S SBC-200 SINGLE BOARD COMPUTER Kit $289.95

S-100 Bus compatible and based on the powerful Z80 microprocessor, the SBC-200 meets the needs of a Z-80 CPU board with many additional features. Ideal for Industrial and control applications. All of the same features that have made the SBC-100 famous, PLUS 4MHz OPERATION. • S-100 Bus Compatible • Z80 Central Processing Unit • 1024 Bytes of Random Access Memory • 8K Bytes of PROM using 2716 • Serial Input/Output Port (with Asynchronous and Synchronous Operation) • Parallel Input and Output Ports • Four Channel Counter/Timer (Z80-CTC) • Software Programmable Baud Rate Generator • No-Front Panel Required for Operation • 4 MHz Operation.

SD'S VERSAFLOPPY II

• IBM 3740 Compatible Soft Sectored Format for Single Density Drives • Operates with Single and Dual Sided Drives, Single or Double Density Drives and 5" & 8" Drives — in any combination of four simultaneously • Drive Select and Side Select Circuitry • S-100 Bus Compatible • Vectored Interrupt Operation Optional • Phase Locked Loop Data Recovery Circuit • Operates with Z80 CPU's • Uses FD1791-1 Controller Chip • Ther Versafloppy II incorporates all the possible features of a flexible disk drive controller into one board. Capable of handling four drives simultaneously, combinations of any variety are possible, such as 5" single sided, 8" dual density dual sided, 5" dual density single sided. Most popular drives are controlled directly with the Versafloppy II. The operating system for the Versafloppy II is the extremely powerful SDOS available for SD Systems. Diagnostic and control software available to complete your disk system.

KIT $335.95

SD'S VDB-8024 VIDEO DISPLAY BOARD

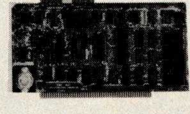
The VDB-8024 features its own on-board Z80 microprocessor. This gives the capability of using software (included in ROM) to control functions and enhancements without interference with the computer's CPU. Included in the special features: 80 characters by 24 lines display, keyboard power and interface, composite and separate video output, 2K on-board RAM, a total of 256 available characters, full cursor control, forward and reverse scrolling, underlining, field reverse, field protect enhancements, programmable characters. **KIT $329.95 A&T $389.95**

SD'S "VERSAFLOPPY I" KIT

FEATURES: IBM 3740 soft sectored compatible, S-100 BNS Compatible for Z-80 or 8080. Controls up to 4 drives (single or double sided). Directly controls the following drives: Sugart SA400/450 Mini Floppy • Shugart SA800/850 Standard Floppy • PERSCI 70 and 277 • MFE 700/750 • CDC 9404/9406

$189.95

SD'S SBC-100 SINGLE BOARD COMPUTER



The SBC-100 provides a complete micro-computer on a single board! The Z80 microprocessor is used as the heart of the SBC-100. The SBC-100 meets all the requirements of a Z80 CPU board with the added features of I/O ports, counter/timer channels, on board RAM, provisions for PROM/ROM and a software programmable baud rate generator. S-100 Bus compatible, the SBC-100 features are: 8K bytes of available PROM, 1024 bytes on-board RAM, Serial I/O with both synchronous and asynchronous operation, Parallel I/O ports, Operational Vectored Interrupts, and Four Counter/Timer Channels. SD Monitor available for RS-232 and Video Terminals. Disk based system software also available.

SBC-100 KIT $249.95

TARBELL FLOPPY DISK INTERFACE

Compatible with Z80 & 8080. S-100 Bus. Uses CPM operating system. Plugs directly into your IMSAI or ALTAIR • Fastest transfer rate

KIT $190.00 Assembled & Tested $260.00

TARBELL CASSETTE INTERFACE

Plugs directly into your IMSAI or ALTAIR • Fastest transfer rate • Extremely reliable • Phase encoded • 4 extra status & control lines

KIT $99.95

SSM CB2 Z-80 CPU Board Kit $186.00

Operates at 2 MHZ or 4 MHZ by DIP switch selection and includes two sockets for 2716 or 2732 EPROMs or TMS 4016 2K RAMs. Jumper options generate the new IEEE S-100 signals.

SSM VB3 80 Character Video Board Kit $299.95

• 80 char. per line, up to 51 lines • Graphics up to 160 × 204 matrix • Up to 256 user defined symbols (optional EPROM) • Composite video

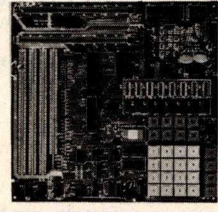
PB1 2708/2716 Programmer & 4K/8K EPROMBoard Kit SSM $124.00

• S-100 bus • 2 separate programming sockets for 2708 or 2716 (5V) EPROMs • Programming voltage generated on board — no need for an external power supply • Software control of 2708/2716 programming selection • LED indicator for programming mode and an on-off switch for programming voltage • 4 sockets for 4K of 2708 or 8K of 2716 EPROMs • Unused EPROM sockets do not enable data bus drive so the board is never committed to the full 4K or 8K of memory • Jumper selectable wait states (0-4) for fast or slow EPROMS

Z80 STARTER KIT

Kit: $279.95 Assembled & Tested $349.95

SD System's Z80 Starter Kit enables the novice to build a complete microcomputer on a single board. Featuring the powerful Z80 microprocessor, the Z80 Starter Kit features • Keyboard and Display • Audio Interface • PROM Programmer • Expansion and Wire Wrap Area • On Board RAM • 4 Channel Counter/Timer • Z-BUG Monitor in PROM • I/O Ports.



NOVATION CAT ACOUSTIC COUPLER/MODEM

$189.00

Let your computer communicate with other computers. Bell Systems 103 compatible 300 baud, answer or originate.

SYM-1

Reg. $269.00
NOW $219.00

- KIM-1 Compatible
- 4K ROM Monitor
- 1K Bytes 2114 RAM
- 65K Memory Expansion
- User EPROM 2716

IO4 2 Parallel/2 Serial I/O Board Kit $126.00

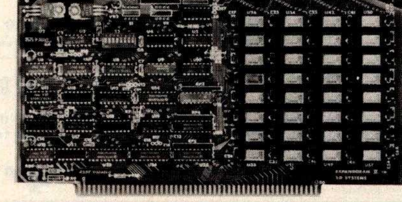
• S-100 bus • 2 serial I/O ports (2 in & 2 out) • Independent baud-rate selection from 55 to 9600 baud • Regulated +5V, +12V & −12V outputs provided on both serial headers • 2 latched parallel I/O ports (2 in & 2 out) • Independent DIP switches for setting address • Interrupt capability provided for on serial and parallel I/O ports • +8V @ 0.95A, +16V @ 0.6A, & −16V @ 80mA typical SSM

VB1B VIDEO BOARD KIT $124.00

• S-100 bus • 64 or 32 characters per line (DIP switch selectable), 16 lines • Graphics 128×48 matrix • Upper case, lower case, Greek characters, symbols and numbers • 7×9 dot character matrix • Black-on-white or white-on-black • Timing 60Hz vertical rate, 16.2KHz horizontal rate, Crystal 12.44MHz • Parallel and composite video output (US TV signals), separate video, horizontal and vertical sync SSM

SD'S EXPANDORAM II
The Random Access Memory

- S-100 Bus Compatible
- Up to 4Mhz Operation
- Expandable Memory from 16K to 256K
- DIP Switch Selectable Boundaries
- Uses 16K (4116) or 64K (4164) Memory Devices
- Page Mode Operation Allows up to 8 Memory Boards on Bus
- Operates with Z80 CPU's
- Phantom Output Disable
- Invisible Refresh (Synchronized with Wait States)



SD Systems' ExpandoRAM II is a dynamic RAM board with capacities from 16K bytes (4116) to 256K bytes (4164). It operates on the industry S-100 Bus. The design allows 8 boards to operate from the same S-100 Bus. The ExpandoRAM II is compatible with most S-100 CPU's based on the Z80 microprocessor.

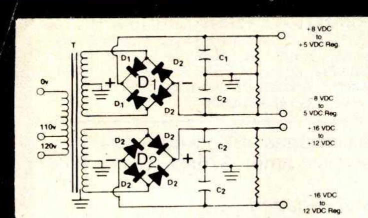
EXPANDORAM II KIT

16K	$295.95
32K	369.95
48K	444.95
64K	519.95

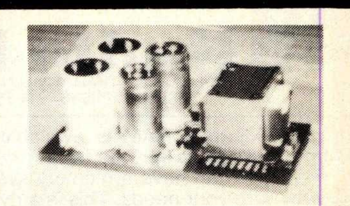
Circle 216 on inquiry card.

Radio Hut Radio Hut Radio Hut Radio Hut

Circle 217 on inquiry card.



BUILD YOUR OWN LOW COST MICRO-COMPUTER POWER SUPPLIES FOR S-100 BUS, FLOPPY DISCS, ETC.



POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

ITEM NO.	USED IN KIT NO.	PRI. WINDING TAPS	SECONDARY WINDING OUTPUTS 2×8 Vac	2×14 Vac	2×24 Vac	SIZE W × D × H	UNIT PRICE
T_1	1	0V, 110V, 120V	2×7.5A	2×2.5A	———	3¾"×3⅝"×3⅛"	21.95
T_2	2	0V, 110V, 120V	2×12.5A	2×3.5A	———	3¾"×4⅜"×3⅛"	27.95
T_3	3	0V, 110V, 120V	2×9A	2×2.5A	2×2.5A	3¾"×4⅜"×3⅛"	29.95
T_4	4	0V, 110V, 120V	2×4A	———	2×3A	3¾"×3⅝"×3⅛"	21.95

POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	USED FOR	@+8 Vdc	@−8 Vdc	@+16 Vdc	@−16 Vdc	@+28 Vdc	SIZE W×D×H	UNIT PRICE
KIT 1	15 CARDS SOURCE	15A	———	2.5A	2.5A	———	12"×6"×4⅞"	51.95
KIT 2	SYSTEM SOURCE	25A	———	3A	3A	———	12"×6"×4⅞"	58.95
KIT 3	DISC SYSTEM	15A	1A	2A	2A	4A	14"×6"×4⅞"	66.95
KIT 4	DISC SOURCE	8A	1A	———	———	5A	10"×6"×4⅞"	49.95

EACH KIT INCLUDES: TRANSFORMER, CAPACITORS, RESIS., BRIDGE RECTIFIERS, FUSE & HOLDER, TERMINAL BLOCK, BASE PLATE, MOUNTING PARTS AND INSTRUCTIONS.

DISC DRIVE POWER SUPPLY "R3" ASSY. & TESTED, OPEN FRAME, SIZE: 9" (W) × 5" (D) × 5" (H) 64.95

SPECS: +5V @ 5A REGULATED, −5V @ 1A REG., +24V @ 5A REG., SHORTS PROTECT.
IDEAL FOR 2 SHUGART 801/851 OR SIEMANS FDD100-8/200-8 DISK DRIVES & ROCKWELL AIM-65.

SHIPPING FOR EACH TRANSFORMER: $4.75. FOR EACH POWER SUPPLY: $5.00 IN CALIF. $7.00 IN OTHER STATES. CALIF. RESIDENTS ADD 6% SALES TAX. OEM WELCOME.

VISA

MAIL ORDER:
P.O. BOX 4296
TORRANCE, CA 90510

SUNNY INTERNATIONAL
(TRANSFORMERS MANUFACTURER)
Telephone: (213) 633-8327

STORE:
7245 E. ALONDRA BLVD.
PARAMOUNT, CA 90723
STORE HOURS: 9 AM–6 PM



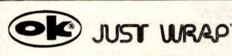
Function Generator KIT XR-2206KB $19.95

8080A MICRO-PROCESSOR $5.95

PET 2001
Professional Computers
TRY THIS ONE!
- 16K Bytes
- Large Keyboard
- Separate Numerics Pad
- Graphics

PET 2001-16N..... $995.00

• EPROM •
5 Volt 2716 $29.90



WIRE WRAPPING TOOL KIT
- 50ft. ea: blue, white, red, yellow wire
- Unwrapping Tool
- JUST WRAP Tool

JWK-6........ $24.95

SYM-1
- KIM-1 Compatible
- 4K ROM Monitor
- 1K Bytes 2114 RAM
- 65K Memory Expansion
- User 2716 EPROM $239.00

Test Clips
14-Pin Clip....$ 4.50
16-Pin Clip....$ 4.75
24-Pin Clip....$10.00
40-Pin Clip....$21.00

ATARI Personal Computer System

400 Includes: Computer Console, Basic Language Cartridge, Power Supply, TV Modulator, and all Operator and Programming Manuals $600.00

800 Includes: Computer Console, Basic Language Cartridge Education System Master Cartridge, Cassette Recorder, TV Modulator, 8K Memory (expandable to 48K), Power Supply and all Operation Manuals $999.00

SD Systems	KITS
27001 ExpandoRAM Kit - Expandable RAM Board Kit (No RAMs)	$220
27002 Versafloppy Flexible Disk Drive Controller Kit	250
27003 SBC-100 Single Board Computer Kit	295
27004 Z80 Starter Kit	340
27007 ExpandoPROM Kit	175
27010 Add-on RAM (16K Devices) 4116 (250nsec)(package of eight devices	165
27011 VDB-8024 Video Display Board Kit	370
27012 ExpandoRAM II Expandable RAM Board Kit (16K RAM)	460
27013 Versafloppy II Flexible Disk Drive Controller Kit	350
27014 PROM-100 PROM Programmer Board Kit	200
27015 MPB-100 Z80 Central Processing Unit Board Kit	250
27017 Add-on RAM (16K devices) 4116 (200nsec)	250
27018 SBC-200 Single Board Computer Kit	320
27024 ExpandoRAM II Expandable RAM Board Kit (No RAMs)	230

SD Systems	ASSEMBLED
38001 ExpandoRAM (16K of on-board RAM)	$ 480
38002 ExpandoRAM (32K of on-board RAM)	620
38003 ExpandoRAM (48K of on-board RAM)	760
38004 ExpandoRAM (64K of on-board RAM)	900
38005 Versafloppy Flexable Disk Drive Controller	335
38006 SBC-100 Single Board Computer	350
38007 Z80 Starter System	450
38010 ExpandoPROM	245
38011 Cable for 8" Disk Drives	80
38013 VDB-8024 Video Display Board	470
38016 Cable, 6ft., 26 Pin Edge Connector (one end)	50
38017 Cable for SD-100/SD-200 Interface to Texas Instruments 810 Printer	80
38018 Cable, same as above (Internal)	120
38019 Cable, same as above (External)	80
38020 ExpandoRAM II (16K Population)	610
38021 ExpandoRAM II (32K Population)	840
38022 ExpandoRAM II (48K Population)	1070
38023 ExpandoRAM II (64K Population)	1300
38024 Versafloppy II Double Density Flexible Disk Drive Controller	430
38025 PROM-100 PROM Programmer	265
38026 MPB-100 Z80 Microprocessor Board	325
38028 SBC-200 Single Board Computer	400

The Instructor 50 Desktop Computer
from SIGNETICS
Complete, Ready-To-Use Microprocessor Learning Package
Includes everything you need to write, run and debug machine-language programs. Housed in one compact package.
$350.00

HICKOK
LX 303
DIGITAL MULTIMETER
Compact Accurate Dependable $74.95



NON-LINEAR SYSTEMS
Portable Mini-Scopes
MS-15............$349
MS-215...........$465
MS-230...........$598

Light Emitting Diode
ED95 Red-Orange and Green
Color mixing possible due to separate anode terminals.
ONLY $1.60

Flasher LED
Red LED and Flasher IC Chip in One Package
ONLY 92¢ ea.

12 Segment LED Array
Excellent for use in level indication circuits.
GL-112R3 All Red
GL-112M2 Green/Red
$4.80 ea.

LED Driver
Designed to illuminate 12 segment LED Arrays according to an input control voltage.
IR-2406 $4.80

KX-33B Micro Computer
Easy-to-use 4-bit microcomputer intended to teach basic concepts of computer technology. Operates on 110VAC, 60Hz. $229.00

★ **15% DISCOUNT COUPON** ★

Bring this **COUPON** into one of our stores or mail to our Mail Order address shown below and receive a **15% DISCOUNT** on purchases from this Ad of $100.00 or more.

Offer EXPIRES on April 30, 1980

NAME..........
ADDRESS..........
CITY.......... STATE..........
ZIP.......... PHONE NO..........

Coupons accepted only with full name and address filled in.

ANCRONA

Send check or Money Order to: **P.O. Box 2208Y, Culver City CA 90230.** California residents add 6% sales tax. Minimum Order; $10.00. Add $1.00 to cover postage and handling. Master Charge and Visa welcomed. Please include your charge card number, Interbank number and expiration date. **PHONE ORDERS: (213) 641-4064**

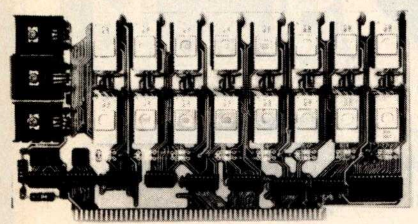
MAIL ORDER	PORTLAND	SANTA ANA	CULVER CITY
P.O. Box 2208R Culver City, CA 90230 (213) 641-4064	1125 N.E. 82nd Ave. Portland, OR 97220 (503) 254-5541	1300 E. Edinger Ave. Santa Ana, CA 92705 (714) 547-8424	11080 Jefferson Blvd. Culver City, CA 90230 (213) 390-3595
TUCSON 4518 E. Broadway Tucson, AZ 85711 (602) 881-2348	**HOUSTON** 2649 Richmond Houston, TX 77098 (713) 529-3489	**ATLANTA** 3330 Piedmont Rd. N.E. Atlanta, GA 30305 (404) 261-7100	**SUNNYVALE** 1054 E. El Camino Real Sunnyvale, CA 94087 (408) 243-4121

Circle 218 on inquiry card.

Circle 219 on inquiry card.

DIGITAL RESEARCH COMPUTERS
(214) 494-1505

16K EPROM CARD-S 100 BUSS



$59.95 KIT

FIRST TIME OFFERED!
BLANK PC BOARD - $28

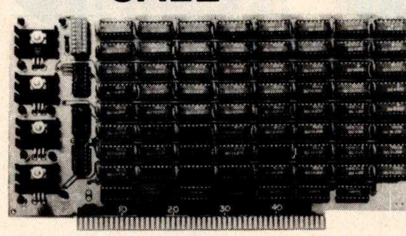
USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

OUR 450 NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

ASSEMBLED AND FULLY TESTED ADD $30

8K LOW POWER RAM KIT-S 100 BUSS
SALE



PRICE CUT!

$119.50 KIT

21L02
(450 NS RAMS!)

Thousands of computer systems rely on this rugged, work horse, RAM board. Designed for error-free, NO HASSLE, systems use.

ASSEMBLED AND FULLY BURNED IN ADD $35

ALL ASSEMBLED BOARDS ARE TESTED AT 4MHZ.

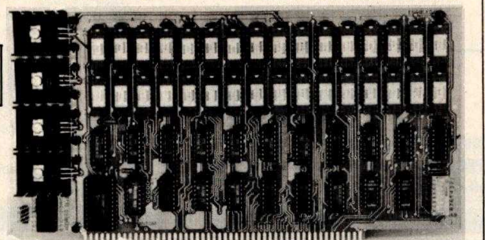
Blank PC Board w/Documentation **$29.95**
Low Profile Socket Set...**13.50**
Support IC's (TTL & Regulators) **$9.75**
Bypass CAP's (Disc & Tantalums) **$4.50**

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$249 KIT

FOR 4MHZ ADD $25



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-**$33**
LOW PROFILE SOCKET SET-**$12**
SUPPORT IC'S & CAPS-**$19.95**
ASSEMBLED & TESTED-**ADD $30**

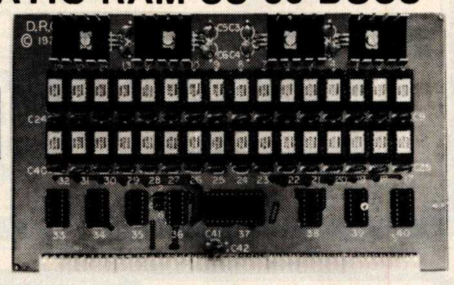
OUR #1 SELLING RAM BOARD!

16K STATIC RAM SS-50 BUSS

PRICE CUT!

$239 KIT

FULLY STATIC AT DYNAMIC PRICES



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Runs at Full Speed
4. Double sided PC Board. Solder mask and silk screened layout. Gold fingers
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—**$26** COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

NEW! STEREO! NEW!
S-100 SOUND COMPUTER BOARD

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

KIT FEATURES:
★ TWO GI SOUND COMPUTER IC'S.
★ FOUR PARALLEL I/O PORTS ON BOARD.
★ USES ON BOARD AUDIO AMPS OR YOUR STEREO.
★ ON BOARD PROTO TYPING AREA.
★ ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
★ PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
★ EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
★ USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basis and Assembly Language Programming examples are included.

COMPLETE KIT! $84.95 (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

SOFTWARE:

SCL Interpreter coming soon! Our new Sound Command Language interpreter along with the Register Examine/Modify (REM) routines and Sound Effects Library (SEL) will be available soon in EPROM. SCL makes sound effects programming generally easier and quicker than that written in Basic or Assembly Language. An SCL users group will be formed, and the best new SCL programs submitted will be added to the Sound Effects Library in EPROM.

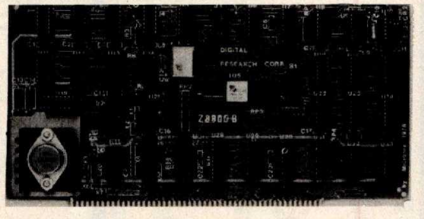
S-100 Z80 CPU CARD

Perfect for OEM's

$169.95

WIRED! NOT A KIT!

4 MHZ



ASSEMBLED AND TESTED! READY TO USE! Over 3 years of design efforts were required to produce a **TRUE** S-100 Z80 CPU at a genuinely bargain price! **BRAND NEW!**

FEATURES:
★ 2 or 4 MHZ Operation. ★ Generates MWRITE, so no front panel required.
★ Jump on reset capability. ★ 8080 Signals emulated for S-100 compatability.
★ Top Quality PCB. Silk Screened. Solder Masked. Gold Plated Contact Fingers.

PRICE CUT! SALE!

LOW POWER - 250NS 2114 RAM SALE!

8 FOR $49.95

4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.
These are the most sought after 2114's, LOW POWER and 250NS FAST.
SPECIAL SALE: $7.50 ea. or 8 FOR 49.95

NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control. 16 Bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy to interface to the S-100 or other busses.
SPECIAL OFFER: $14.95 each Add $3 for 60 page Data Manual.

Digital Research Computers
(OF TEXAS)
P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 494-1505

TERMS: Add $1.00 postage, we pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa and MasterCharge. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items. Orders over $50. add 85¢ for insurance.

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

Circle 222 on inquiry card.

LEADER Instruments Corp. OSCILLOSCOPES

2 YEAR WARRANTY



Model LBO-507

20 MHz, TRIGGERED
- Single trace; automatic trigger for highly stable, bright display.
- 17.5nSec rise time.
- 10mV/cm to 20V/cm Vertical Sensitivity; 11 steps.



Model LBO-508

20 MHz, DUAL TRACE
- Add, subtract modes on CH-1 & CH-2 facilitate easy checkout for simultaneous pulses, signal levels, distortion & noise cancelling.



Model LBO-515

25 MHz, DELAYED SWEEP, DUAL TRACE
- Built in variable delay circuitry — 1μSec to 5 Sec.
- 5mV/Div. Vertical Sensitivity.



Model LBO-520

30 MHz, FIXED DELAY, DUAL TRACE
- Dual trace, 30 MHz bandwidth.
- 5mV/cm Vertical Sensitivity.

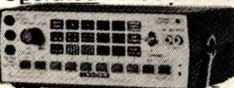
COLOR BAR GENERATORS, BRIDGES, TESTERS.

NTSC Color Bar Pattern Generator



Model LCG-396
- NTSC color bars.
- Provides full-field or IQW insertion, plus on-off control of chroma and luminance.
- Better checking and adjusting of purity and white balance via red, blue, green, white rasters.
- Dots and single crossbars for convergence, raster and all other alignment requirements.
- 75Ω Video (1 Volt fixed) and RF output for TV and VTR equipment.
- Equalizing pulse phase locked to color sub-carrier.
- Adjustable scanning control permits progressive or interlaced scanning to eliminate flicker.
- Provides all signals required to time, test & evaluate all MATV, CATV, VTR/VCR, color and b&w systems.

Completely Portable, Battery Operated TV Color Analyzer



Model LCG-397
- RF, IF, composite video outputs.
- 0-100% variable color burst for easy chroma service.
- 18 convergence patterns — 10 bar gated, 3 bar gated and rainbow patterns.
- 3 dot patterns, 2 crosshatch patterns.
- 3 vertical lines and 3 horizontal lines plus gray scale.
- Oscilloscope trigger outputs.
- Battery operated: 4 standard "C" cells, 1.5V each.

Transistorized LCR Bridge



Model LCR-740
- Highly accurate 3 digit readout.
- Measures Inductance (L), Capacitance (C) and Resistance (R), within ± 0.5% accuracy.
- Readouts variable with built-in 10% overrange.
- Loss Factor scale (D).
- Operates on 1 9V battery or through built-in AC adapter.

The Automatic Transistor Checker



Model LTC-906
- Automatically checks transistors, FET's diodes, good/bad, in or out of circuit.
- Automatically identifies Germanium or Silicon.
- Automatically identifies elements.
- Automatically tests broad range of parameters with simple, program on/off switches.
- LED display plus audible tone indicates defective or good performance.
- Absolute meter readout of H_{fe}, B_{ve} and Leakage current.
- Totally portable, battery operated — 9V battery.

Before you buy, check our prices...
Call TOLL FREE (800) 645-9518
In N.Y. State call (516) 752-0050

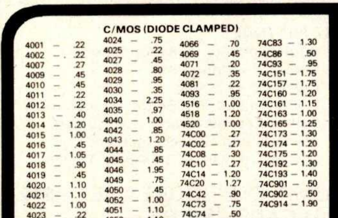
FORDHAM RADIO SUPPLY CO. INC
855 Conklin St.
Farmingdale, N.Y.11735

YOUR ONE STOP DISCOUNT CENTER
Master Charge, Bank Americard, Visa, C.O.D.'s accepted.

"We Will Beat Any Advertised Price"

CODs, shipping and insurance extra

N.Y. State residents add appropriate sales tax



C/MOS (DIODE CLAMPED)

4001	.22	4024	.75	4066	.70	74C83	1.30
4002	.22	4025	.22	4069	.45	74C86	.50
4007	.27	4027	.45	4071	.20	74C93	.95
4009	.45	4028	.80	4072	.35	74C151	1.75
4010	.45	4029	.95	4081	.22	74C157	1.75
4011	.22	4030	.35	4093	.95	74C160	1.20
4012	.22	4034	2.25	4516	1.00	74C161	1.15
4013	.40	4035	.97	4518	1.20	74C163	1.00
4014	1.20	4040	1.00	4520	1.00	74C165	1.25
4015	1.00	4042	.85	74C00	.27	74C173	1.30
4016	.45	4043	1.20	74C02	.27	74C174	1.20
4017	1.05	4044	.85	74C08	.30	74C175	1.20
4018	.90	4045	.45	74C10	.27	74C192	1.30
4019	.45	4046	1.95	74C14	1.20	74C193	1.40
4020	1.10	4049	.75	74C20	1.27	74C901	.50
4021	1.10	4050	.45	74C42	.90	74C902	.50
4022	1.00	4052	1.00	74C73	.75	74C914	1.90
4023	.22	4051	1.10	74C74	.50		
		4053	1.10				

TTL REED RELAY — SPST 5V 20ma $1.00

		4116-3 16K STATIC RAM 300 NS	5.50
1488-RS232 INTERFACE —	$1.40	5280/2107B 4K DYN RAM —	3.40
1489-RS232 INTRFACE —	1.25	TMS 4050L —	3.95
2509-TRI STATE STAT. SR —	1.35	82S23 —	1.95
2518-HEX 32 BIT SR —	2.20	82S129 —	3.25
2522-STATIC SHIFT REG. —	1.95	82S123 —	2.95
2708-8K EPROM (450 ns) —	9.95	82S126 —	2.95
TMS-3409 NC 80 BITS DYN. S.R.	1.35	82S131 —	3.95
2716-(TI)-3 VOLTAGES	24.95	AY5 1013 VART —	5.25
2716-(Intel) + 5V	35.95	TRI 602B —	4.95
2102-1 (450 ns) —	.90	8703C TELEDYNE 8 BIT AD CONVERT —	9.95
21L02-1 (450 ns) —	1.10		
MM5270 4K X1 DYN. —	3.45	PT 1482-B PSAT —	6.95
MK4008P —	1.95	MCM 6571A 7x9 Character gen	10.75
2101-1 254 × 4 STATIC —	2.45	MM5321-TU SYNC GEN.	13.95
2111-1 256 × 4 STATIC —	3.45	8080A —	7.75
2112-1 256 × 4 STATIC —	2.75	8205	3.95
2114-4K STAY. RAM (450 ns) —	5.95	8228	4.95
2117-16K DYN RAM —	7.95	8225.5	5.95
UPD410-1-4K STAT. RAM —	9.95	8251	6.95
4116-2 16K RAM 150 NS	9.95	8834 —	2.25

8130 - 2.95 8T380 - 2.25 8837 - 2.25
8131 - 2.95 8830 - 2.95 8838 - 2.25
8833 - 2.50

DATEL'S DAC-08BC — 8 bit DAC — $9.95

8" DISKETTES — HARD SECTOR
$1.75, 10/$16.00

CRYSTALS $3.45 ea.
2.000 MHz 6.144 MHz
4.000 MHz 8.000 MHz
3.57 MHz 10.000 MHz
5.000 MHz 20.000 MHz
6.000 MHz

RIBBON CABLE
FLAT (COLOR CODED)
#30 WIRE
26 cond. - .50/per foot
40 cond. - .75/per foot
50 cond. - .90/per foot

UNIVERSAL 4Kx8 MEMORY BOARD KIT
$69.95
32-2102-1 fully buffered, 16 address lines, on board decoding for any 4 of 64 pages, standard 44 pin buss, may be used with F-8 & KIM

SILICON SOLAR CELLS
4" diameter .4V at 1 AMP. $10.00

LED READOUTS

FCS 8024 - 4 digit C.C. 8" display	$5.95	DL-707 C.A. .3"	$ .75
FND 503 C.C. .5"	$ .85	DL 747 C.A. .6"	$1.50
FND 510 C.A. .5"	$ .85	HP3400 .8" CA	$1.95
DL-704-.3" C.C.	$ .85	HP3405 .8" CC	$1.95

PRINTED CIRCUIT BOARD

4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" thick $.60 ea .... 5/$2.60

EPOXY glass vector board 1/16" thick with 1/10" spacing $1.95

CONTINENTAL SPECIALTIES

MAX 100 Freq. counter. An 8 digit 100 MHz counter AC or DC input. — $129.00

#2001 1Hz — 100KHz Function Generator, sine, square & triangle output. — $159.00.

7 WATT LD-65 LASER DIODE IR $8.95

25 watt Infra Red Pulse (SG 2006 equiv.) Laser Diode (Spec sheet included) $24.95

MINIATURE MULTI-TURN TRIM POTS
100. 2K, 5K, 10K, 20K, 250K, 1 Meg, $.75 each ... 3/2.00

2N3820 P FET .... $ .45
2N 5457 N FET .... $ .45
2N2646 UJT .... $ .45
ER 900 TRIGGER DIODES .... 4/$1.00
2N 6028 PROG. UJT .... $ .65

FP 100 PHOTO TRANS. .... $ .50
RED, YELLOW, GREEN LARGE LED's. 2" .... 6/$1.00
RED/GREEN BIPOLAR LED's. 2" .... $ .95
TIL-118 OPTO-ISOLATOR .... $ .75
MCT-6 OPTO ISOLATOR .... $ .80
1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 9.1, 10, 12, 15, 18, or 22V .... 6/$1.00

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	3.70	5.00
200	.07	.20	.40	1.30	4.25	6.50
400	.09	.25	.65	1.50	6.50	9.60
600	.11	.30	.80	2.00	8.50	12.50
800	.15	.35	1.00	2.50	10.50	16.50
1000	.20	.45	1.25	3.00	12.50	20.00

SAD 1024 a REDICON 1024 stage analog "Bucket Brigde" shift register. $9.95

IN 4148 (IN914) .... 15/$1.00
.1 or .01 uf 25V ceramic disc. caps. 16/$1.00, 100/$50.00

RS232 CONNECTORS
DB 25P male $2.95
DB 25S female $3.50
HOODS $1.50

REGULATORS

323K - 5V 3A	$5.75	340K - 12, 15 or 24 V	$1.50
309K	$1.60	340T - 5, 6, 8, 12, 15, 18 or 24 V	$1.30
723	$ .50	79MG	$1.35
320T - 5, 12, or 15 V	$1.30	78MO5	$ .75

TRANSISTOR SPECIALS

2N6233-NPN SWITCHING POWER $1.95
MRF-8004 a CB RF Transistor NPN .... $ .75
2N3772 NPN Si TO-3 .... $1.00
2N4908 PNP Si TO-3 .... $1.00
2N4908 PNP Si TO-3 .... $1.00
2N5086 PNP Si TO-92 .... 4/$1.00
2N3137 NPN Si RF .... $ .55
2N3919 NPN Si TO-3 RF $1.50
2N1420 NPN Si TO-5 .... 3/$1.00
2N3767 NPN Si TO-66 .... $ .70
2N2222 NPN Si TO-18 .... 5/$1.00
2N3055 NPN Si To-3 .... $ .60
2N3904 NPN Si TO-92 .... 6/$1.00
2N5296 NPN Si TO-220 .... $ .55
2N3638 PNP Si TO-5 .... 5/$1.00
MPSA 13 NPN Si .... 4/$1.00
2N1546 PNP GERM TO-3 .... $ .95

TTL IC SERIES

7400	.17	7450	.17	74155	.75
74101	.17	7472	.35	74157	.65
7402	.17	7473	.35	74160	.85
7403	.17	7474	.42	74161	.80
7404	.24	7475	.49	74162	1.20
7405	.24	7476	.45	74163	.82
7406	.33	7480	.45	74164	.85
7408	.27	7483	.60	74165	.85
7409	.24	7485	.75	74170	1.60
7410	.17	7486	.42	74173	1.30
7411	.22	7489	1.60	74174	.85
7412	.22	7490	.50	74175	.75
7413	.42	7491	.55	74176	.75
7414	.90	7492	.50	74177	.75
7416	.33	7493	.50	74180	.75
7417	.37	7494	.60	74181	1.90
7420	.17	7495	.60	74190	1.20
7425	.35	7496	.60	74191	1.20
7426	.33	74107	.35	74192	.79
7427	.35	74121	.35	74193	.79
7430	.17	74122	.39	74194	.85
7432	.27	74123	.42	74195	.65
7437	.27	74125	.45	74196	.85
7438	.27	74126	.45	74197	.85
7440	.17	74145	.75	74279	.75
7441	.85	74148	1.10	74368	.65
7442	.50	74150	1.10	74325	2.25
7445	.70	74151	.65	75491	1.05
7447	.60	74153	.55	75492	1.05
7448	.75	75154	1.10	8T97	1.25
				8T98	1.10

14 pin headers 3/$1.00
16 pin headers $.40 ea.

MM5387AA .... CLOCK CHIPS $5.95
MM5314 .... $4.75

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' $1.40

ALCO MINIATURE TOGGLE SWITCHES
MTA 106 SPDT $1.05
MTA 206 DPDT $1.70
MTA 206 P-DPDT CENTR OFF $1.85
MSD 206 P-DPDT CENTER OFF LEVER SWITCH $1.85

Full Wave Bridges

PRV	2A	6A	25A
100			1.40
200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

DIP SOCKETS

8 PIN	.17	24 PIN	.35
14 PIN	.20	28 PIN	.40
16 PIN	.22	40 PIN	.60
18 PIN	.25		

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS .... $ 6.75
Si 1020 G 20 WATTS $12.95
Si 1050 G 50 WATTS $25.90

TANTULUM CAPACITORS

.22UF 35 V	5/$1.00	6.8 UF 35V	4/$1.00
.47UF 35 V	5/$1.00	10UF 10V	$ .25
.68UF 35 V	5/$1.00	22UF 25V	$ .40
1UF 35V	5/$1.00	15UF 35V	3/$1.00
2.2UF 20V	5½ $1.00	30UF 6V	5/$1.00
3.3UF 20V	4/$1.00	100UF 15V	$ .70
4.7 UF 15 V	5/$1.00	150 UF 15V	$ .95

74LS SERIES

74LS00	.28	74LS153	1.19
74LS01	.29	74LS155	1.19
74LS02	.28	74LS156	1.19
74LS03	.28	74LS157	1.19
74LS04	.35	74LS160	1.10
74LS05	.35	74LS162	1.10
74LS08	.35	74LS163	1.20
74LS09	.35	74LS164	1.20
74LS10	.30	74LS168	1.25
74LS11	.45	74LS169	1.25
74LS12	.35	74LS170	1.70
74LS13	.95	74LS173	1.30
74LS14	1.95	74LS174	1.00
74LS15	.35	74LS175	1.00
74LS20	.30	74LS181	2.50
74LS21	.55	74LS190	1.25
74LS22	.35	74LS191	1.15
74LS26	.35	74LS192	1.00
74LS27	.45	74LS193	1.10
74LS28	.45	74LS195	1.10
74LS30	.35	74LS196	1.20
74LS32	.40	74LS221	1.30
74LS37	.45	74LS197	1.10
74LS38	.55	74LS240	2.50
74LS40	.40	74LS241	2.95
74LS42	1.00	74LS242	3.00
74LS51	.35	74LS243	2.75
74LS54	.35	74LS244	2.50
74LS73	.45	74LS251	1.29
74LS74	1.05	74LS257	.90
74LS75	.59	74LS258	1.50
74LS76	.45	74LS259	1.50
74LS86	.45	74LS266	.70
74LS90	.90	74LS279	.70
74LS92	.90	74LS290	.80
74LS93	.90	74LS293	.80
74LS107	.45	74LS295	1.50
74LS109	.45	74LS298	1.50
74LS112	.45	74LS365	.80
74LS113	.45	74LS366	.80
74LS114	.55	74LS367	.80
74LS125	.90	74LS368	.80
74LS126	.90	74LS375	.95
74LS132	.95	74LS377	2.75
74LS139	1.30	74LS386	.50
74LS151	1.19	74LS390	1.95

LINEAR CIRCUITS

LM201 — .75
LM301/748 — .25
LM307 — .30
LM308 — .75
LM311 — .75
LM318 — 1.20
LM324 — .95
LM339 — 1.10
LM358 — .70
LM377 — 1.60
LM380 — .95
LM382 — 1.25
LM386 — .80
LM387 — 1.25
LM1808 — 1.75
LM1889 — 1.95
CA3080 — .95
LM537 — 2.50
LM553 — 2.50
LM555 — .49
LM556 — .85
560 — 2.00
565 — .95
566 — 1.10
567 — 1.10
702 — 1.50
703 — .95
709 — .25
710 — .45
711CH — .40
741C or V — .30
747 — .50
LM1310 — 2.50
1456 — .95
1458 — .50
3900 — .65
8038CC — 3.90
791 — 1.95
4136 — .95
LF355 — 1.75

SCR'S

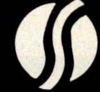
1.5A	6A	35A
.45	.60	1.40
.70	.80	1.90
1.20	1.40	2.60
	1.80	3.60

TRIACS

PRV	1A	10A	25A
100	.45	.80	1.55
200	.84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

Terms: FOB Cambridge, Mass
Send Check or Money Order
Include Postage, Minimum
Telephone, C.O.D. Purchase
Order or Charge $20.00.
Minimum Mail Order $5.00.

Send 25¢ for our catalog featuring Transistors and Rectifiers
145 Hampshire St., Cambridge, Mass.



SOLID STATE SALES
P.O. BOX 74B
SOMERVILLE, MASS. 02143 TEL. (617) 547-7053

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

P.O. Box 4430X, Santa Clara, CA 95054
Will calls: 2322 Walsh Ave.
(408) 988-1640

Quest ELECTRONICS

NEW PRODUCTS!

Super Color S-100 Video Kit $99.95
Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Gremlin Color Video Kit $59.95
32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. Not expandable to high resolution Graphics.

Elf II Adapter Kit $24.50
Plugs into Elf II providing Super Elf 44 and 50 pin bus plus S-100 bus expansion (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

1802 16K Dynamic RAM Kit $149.00
1802/S-100 expandable to 32K, Hidden refresh w/clocks up to 4 MHz w/no wait states Addl. 16K RAM **$79.00.**

Quest Super Basic

Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a **full size Basic** for 1802 systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer ±2 billion; Multi dim arrays; String arrays; String manipulation; Cassette I/O, Save and load, Basic, Data and Machine language programs; and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

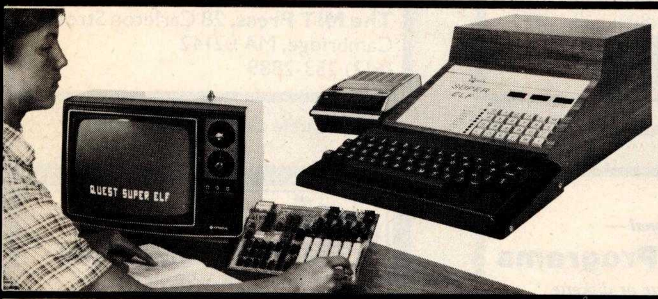
Super Basic on Cassette $40.00

Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before. $19.00

S-100 4-Slot Expansion $ 9.95

Super Monitor VI.I Source Listing $15.00

Coming Soon: Assembler, Editor, Disassembler, DA/AD, Super Sound/Music, EPROM programmer, Stringy Floppy Disc System.



RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year. Issues 1-12 bound $16.50.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow you to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

7400TTL	
7400N	.17
7402N	.18
7404N	.19
7409N	.23
7410N	.18
7414N	.70
7420N	.18
7422N	.39
7430N	.20
7442N	.50
7445N	.69
7447N	.60
7448N	.69
7450N	.18
7474N	.35
7475N	.49
7485N	.88
7489N	1.85
7490N	.43
7492N	.43
7493N	.43
7495N	.69
74100N	.90
74107N	.35
74121N	.34
74123N	.59
74125N	.45
74145N	.69
74150N	.95
74151N	.69
74154N	1.00
74157N	.69
74161N	.87
74162N	.87
74163N	.87
74174N	.96
74175N	.90
74190N	1.15
74192N	.87
74193N	.85
74221N	2.00
74298N	1.65
74365N	.66
74366N	.66
74367N	.66

74LS00 TTL	
74LS00N	.35
74LS02N	.35
74LS04N	.35
74LS05N	.35
74LS08N	.35
74LS10N	.35
74LS13N	.55
74LS14N	1.10
74LS20N	.35
74LS22N	.35
74LS28N	.41
74LS30N	.35
74LS33N	.75
74LS38N	.55
74LS74N	1.25
74LS75N	1.00
74LS90N	.85
74LS93N	.70
74LS95N	1.10
74LS107N	.45
74LS112N	.45
74LS113N	.35
74LS132N	.89
74LS136N	.45
74LS151N	.85
74LS155N	.85
74LS157N	.85
74LS162N	1.15
74LS163N	1.15
74LS174N	2.00
74LS190N	1.06
74LS221N	1.95
74LS258N	.67
74LS367N	1.35

LINEAR	
CA3045	.90
CA3046	1.10
CA3081	1.80
CA3082	1.90
CA3089	2.95
LM301AN/AH	.35
LM305H	.87
LM307N	.35
LM308N	.89
LM309K	1.50
LM311H/N	.90
LM317T/K	3.75
LM318	1.35
LM320K-5	1.50
LM323K-5	5.95
LM320K-12	1.50
LM320K-15	1.50
LM320T-5	1.60
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-8	1.25
LM340T-12	1.25
LM340T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM343H	4.50
LM350	7.50
LM370	1.15
LM377	3.00
LM379	5.00
LM380N	1.00
LM381	1.60
LM382	1.60
LM703H	.40
LM709H	.28
LM723H/N	.50
LM733N	.67
LM741CH	.35
LM741N	.32
LM747H/N	.75
LM748N	.35
LM1303N	1.75
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
LM1800	1.75
LM1812	7.50
LM1889	3.00
LM2111	1.75
LM2902	1.50
LM3900N	.60
LM3905	1.75
LM3909N	.89
MC1458V	.50
NE540H	3.75
NE550N	1.00
NE555V	.39
NE556A	.85
NE565A	1.00
NE566V	1.50
NE567V	1.00
NE570B	5.00
78L05	.60
78L08	.60
78M05	.85
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89

A to D CONVERTER	
8038B	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	9.95
9400CJV/F	7.40
ICL7103	9.50
ICL7107	14.25

CMOS	
CD34001 Fair.	.50
CD4000	.16
CD4001	.28
CD4002	.28
CD4006	1.10
CD4007	.28
CD4008	.28
CD4009	.45
CD4010	.45
CD4011	.28
CD4012	.28
CD4013	.39
CD4014	1.00
CD4015	1.00
CD4016	.45
CD4017	1.05
CD4018	.94
CD4019	.45
CD4020	1.02
CD4021	1.25
CD4022	1.10
CD4023	.28
CD4024	.75
CD4025	.28
CD4026	2.00
CD4027	.66
CD4028	.85
CD4029	1.02
CD4030	.45
CD4035	1.02
CD4040	1.02
CD4042	.85
CD4043	.85
CD4044	.85
CD4046	1.67
CD4049	.45
CD4050	.49
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.50
CD4071	.28
CD4072	.28
CD4073	.28
CD4075	.28
CD4076	1.45
CD4078	.40
CD4081	.28
CD4082	.28
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	3.50
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.40
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
74C154	3.00
74C160	1.44
74C175	1.35
74C192	1.65
74C221	2.00
74C905	6.00
74C906	.75
74C914	1.95
74C922	5.50
74C923	5.50
74C925	6.95
74C926	6.95
74C927	6.95

INTERFACE	
8095	.65
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69

MOS/MEMORY RAM	
2101-1	3.95
2102-1	.95
2102AL-4	1.25
2102AN-2L	1.60
21L02-1	1.18
2104A-4	4.95
2107B-6	3.75
2111-1	3.75
2112-2	3.95
2114L 300ns	7.40
4116 200ns	9.50
8/4116 200ns	64.00
2513B	6.30
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	8.95
4200A	9.95
82S25	2.90
91L02A	1.50
HD0165-5	6.95
MM57100	4.50
GIAY38500-1	9.95
MCM66751A	9.95
9368	3.50
410D	10.00
416	16.00

CLOCKS	
MM5311	5.50
MM5312	3.90
MM5314	3.90
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7001	5.80
CT7010	8.95
CT7015	8.95
MM5375AA/N	3.90
MM5375AG/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0056CN	3.75
MM53104	2.50

MICROPROCESSOR	
6502	12.50
6504	16.50
6522	13.60
6800	17.50
6802	18.75
6820	9.95
6850	12.95
8080A	8.95
8085	27.00
8086	75.00
Z80	14.75
Z80A	19.75
8212	2.90
8214	8.00
8216	2.90
8224	2.90
8228	5.35
8251	8.50
8253	15.00
8255	9.25
8257	19.50
8259	19.50
1802CP plas.	13.95
1802DP plas.	17.95
1861P	11.50
CDP1802CD	19.95
CDP1802D	25.00
CDP1861	12.95

UART/FIFO	
AY5-1013	5.50
AY5-1014	7.50
3341	6.95

PROM	
1702A	3.95
2513B upper case	6.95
2708	7.75
2716T1	24.50
2716 Intel	34.95
8/2716 Intel	240.00
2732	85.00
2758	22.50
8741A	85.00
8748	75.00
8748-8	70.00
8755A	65.00
N82S23	2.95
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
DM8577	2.90
8223	2.90
8/2716 Intel	240.00

CONNECTORS	
30 pin edge	2.50
44 pin edge	2.75
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS
Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.32	24	.86
16	.33	28	1.00
18	.57	40	1.23

CRYSTALS	
1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32 MHz	3.90
32768 Hz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

KEYBOARD ENCODERS	
AY5-2376	$12.50
AY5-3600	17.95
AY5-9100	10.50
AY5-9200	16.50
74C922	5.50
74C923	5.50
HD0165-5	6.95

D Connectors RS232	
DB25P	2.95
DB25S	3.95
Cover	1.50
RS232 Complete Set	6.50
DE9S	1.95
DA15P	2.10
DA15S	3.10

Hickok 3½ Digit LED multimeter 69.95
Stopwatch Kit 26.95
Auto Clock Kit 17.95

Not a Cheap Clock Kit $14.95
Includes everything except case. 2-PC boards. 6- .50" LED Displays. 5314 clock chip, transformer, all components and full instructions. Orange displays also avail. **Same kit w/.80" displays.** Red only. **$21.95** Case **$11.75**

8K/16K Eprom Kit (less PROMS) $89.00
Motherboard $39.00
Extender Board $8.99

RESISTORS ¼ watt 5%
10 per type .03 — 1000 per type .012
25 per type .025 — 350 piece pack
100 per type .015 — 5 per type 6.75
½ watt 5% per type .05

KEYBOARDS	
56 key ASCII keyboard kit	$67.50
Fully assembled	77.50
53 key ASCII keyboard kit	60.00
Fully assembled	70.00
Enclosure	14.95
Metal Enclosure	29.95

LEDS	
Red T018	.15
Green, Yellow T018	.20
Jumbo Red	.20
Green, Orange, Yellow Jumbo	.25
Cliplite LED Mounting Clips	8/$1.25

(specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $128.95

OK WIRE WRAP TOOLS in stock
Portable Multimeter $18.00

SPECIAL PRODUCTS	
MM5865 Stopwatch Timer with 10 pg. spec.	9.00
PC board	7.50
Switches Mom. Pushbutton	.27
3 pos. slide	.25
Encoder HD0165-5	6.95
Paratronics 100A Logic Analyzer Kit	**$224.00**
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
Sinclair 3½ Digit Multimeter	**$59.95**
Clock Calendar Kit	**$23.95**
2.5 MHz Frequency Counter Kit	**$37.50**
30 MHz Frequency Counter Kit	**$47.75**

TRANSFORMERS	
6V 300 ma	3.25
12 Volt 300 ma transformer	1.25
12.6V CT 600 ma	3.75
12V 250 ma wall plug	2.95
12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
10V 1.2 amp wall plug	4.85
12V 6 amp	12.95
12V 500 ma wall plug	4.75
12V 1 amp wall plug	6.50
12V 3 amp	8.50
10/15 VAC 8/16 VA wall plug	9.75

DISPLAY LEDS			
MAN1	CA	.270	2.90
MAN3	CC	.125	.39
MAN72/74	CA/CA	.300	1.00
DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			.60
4 digit Bubble			.80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
10 digit display			1.25
7520 Clairex photocells			.39
TIL311 Hex			9.50
MAN3640	CC	.30	1.10
MAN4610	CA	.40	1.20
MAN4640	CC	.40	1.20
MAN4710	CA	.40	.95
MAN4740	CC	.40	1.20
MAN6640	CC	.56	2.95
MAN6710	CA	.60	1.35
MAN6740	CC	.60	1.35

MA1002A	**8.95**
MA1002E	**8.95**
MA1012A	**8.95**
102P3 transformer	**2.25**

ROCKWELL AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00.

Special small power supply for AIM65 assem. in frame **$49.00.** Complete AIM65 in thin briefcase with power supply **$485.00.** Molded plastic enclosure to fit AIM65 plus power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$599.00**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

AIM65/KIM/VIM I/O Expansion Kit; 4 parallel and 2 serial ports plus 2 internal timers **$39.00.** PROM programmer for 2716 **$150.00.**

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12 option. ±5v, ±12v are regulated. Kit $29.95. Kit with punched frame $37.45, $4.00 shipping. Kit of hardware $14.00. Woodgrain case $10.00, $1.50 shipping.

PROM Eraser

Will erase 25 PROMs in 15 minutes. Ultraviolet, assembled **$37.50**
Safety switch/Timer version **$69.50**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

LRC 7000+Printer $389.00

40/64 column dot matrix impact, std. paper. Interface all personal computers.

Televideo Terminal $845.00

102 key, upper, lowercase, 10 Baud rates 24 x 80 char. microprocessor cont. edit. cap.

Intertube II Terminal $874.00

Super Brain

Floppy Disk Terminal $2895.00

79 IC Update Master Manual $29.95

Complete IC data selector, 2500 pg. master reference guide. Over 50,000 cross references. Free update service through 1979. Domestic postage $3.50. No foreign orders.

S-100 Computer Boards

8K Static RAM Kit	$135.00
16K Static RAM Kit	265.00
24K Static RAM Kit	423.00
32K Static RAM Kit	475.00
16K Dynamic RAM Kit	199.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
Video Interface Kit	**$129.00**

Video Modulator Kit $8.95

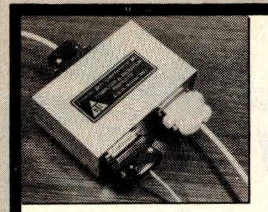
Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Digital Temp. Meter Kit $34.00

Indoor and outdoor. Switches back and forth. Beautiful. 50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, tenths of a degree, air or liquid. Beautiful woodgrain case w/bezel **$11.75**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
BankAmericard and Master Charge accepted.
Shipping charges will be added on charge cards.

FREE: Send for your copy of our NEW 1980 QUEST CATALOG. Include 28¢ stamp.



TERMINAL DATA CORPORATION

MODEL 1200 RS-232 DATA SPLITTER

available in kit form

Model 1200K gives the terminal or microprocessor user a second interface for a printer, plotter, cassette or tape drive. It operates at any speed & isolates the two output devices from each other, while providing 2 RS-232 interfaces from the terminal or microprocessor.

The kit consists of 3 RS-232 connectors, printed circuit board, all necessary components, enclosure, mounting hardware & assembly instructions $64.00

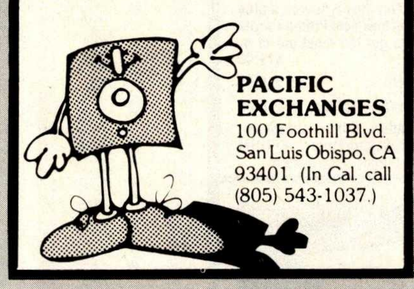
write or call

TERMINAL DATA CORP.
11878 Coakley Cir.
Rockville, MD 20852
(301) 881-7655

Circle 226 on inquiry card.

MEMOREX
Floppy Discs

Lowest prices. **WE WILL NOT BE UNDERSOLD!!** Buy any quantity 1-1000. Visa, Mastercharge accepted. Call free (800)235-4137 for prices and information. All orders sent postage paid.



PACIFIC EXCHANGES
100 Foothill Blvd.
San Luis Obispo, CA
93401. (In Cal. call
(805) 543-1037.)

Circle 227 on inquiry card.

NEW FROM THE MIT PRESS!

Computer Music Journal

a respected source of information on applications of computers to music

Beginning and advanced articles on: composition algorithms and languages • synthesis of sound • digital signal processing • microprocessor applications • psychoacoustics • computers in musicology
Current literature and recordings
Products of interest
Interviews, conference listings

4 issues a year/$20.00, individuals/
$30.00, institutions

The MIT Press, 28 Carleton Street
Cambridge, MA 02142
(617) 253-2889

Circle 228 on inquiry card.

Word Processing for UCSD Pascal

PROFF formats and prints out text files. FORML interacts with PROFF to produce multiple copies of a form letter, each with a different addressee. Features include:

—multi file input
—interactive debug
—adjustable margins
—filling, centering
—underscoring

Each program is written in UCSD Pascal and is distributed on floppy disk. User manuals are included or can be purchased separately. Volume discounts are available.

(714) 452-0681
Renaissance Systems Inc.
11760 Sorrento Valley Rd.
San Diego, Ca. 92121

Circle 229 on inquiry card.

—Professional—

Real Estate Programs

available on cassette or diskette
for Apple & TRS-80 II

Property Management System
- Rental Income Tracking
- Complete Expense Analysis

System w/Manual $225.00
Manual $15.00

Program Modules:
1) Home Purchase Analysis
2) Income Property Cashflow/Leverage
3) Construction Cost/Profit
4) Tax Deferred Exchange
5) APR Loan Analysis

Price Per Module $30.00
Add $5.00 for Programs on Diskette



At Computer Stores everywhere or call (213) 372-9419 for C.O.D.

2045 Manhattan Ave., Hermosa Beach, CA 90254

Circle 230 on inquiry card.



Circle 231 on inquiry card.



Circle 232 on inquiry card.

A better way to pay for your business system.

Our lease plans have saved a lot of businesses a lot of money on new equipment. A low monthly payment lets you acquire the system you need at a price you can afford. To find out more, just call us. Do it now.

DATALEASE CORPORATION

P. O. Box 467, Westport, CT 06880
(203) 226-9582
The small systems financing specialists.

Circle 233 on inquiry card.

WANTED:
Computer Operators

with your own microprocessor

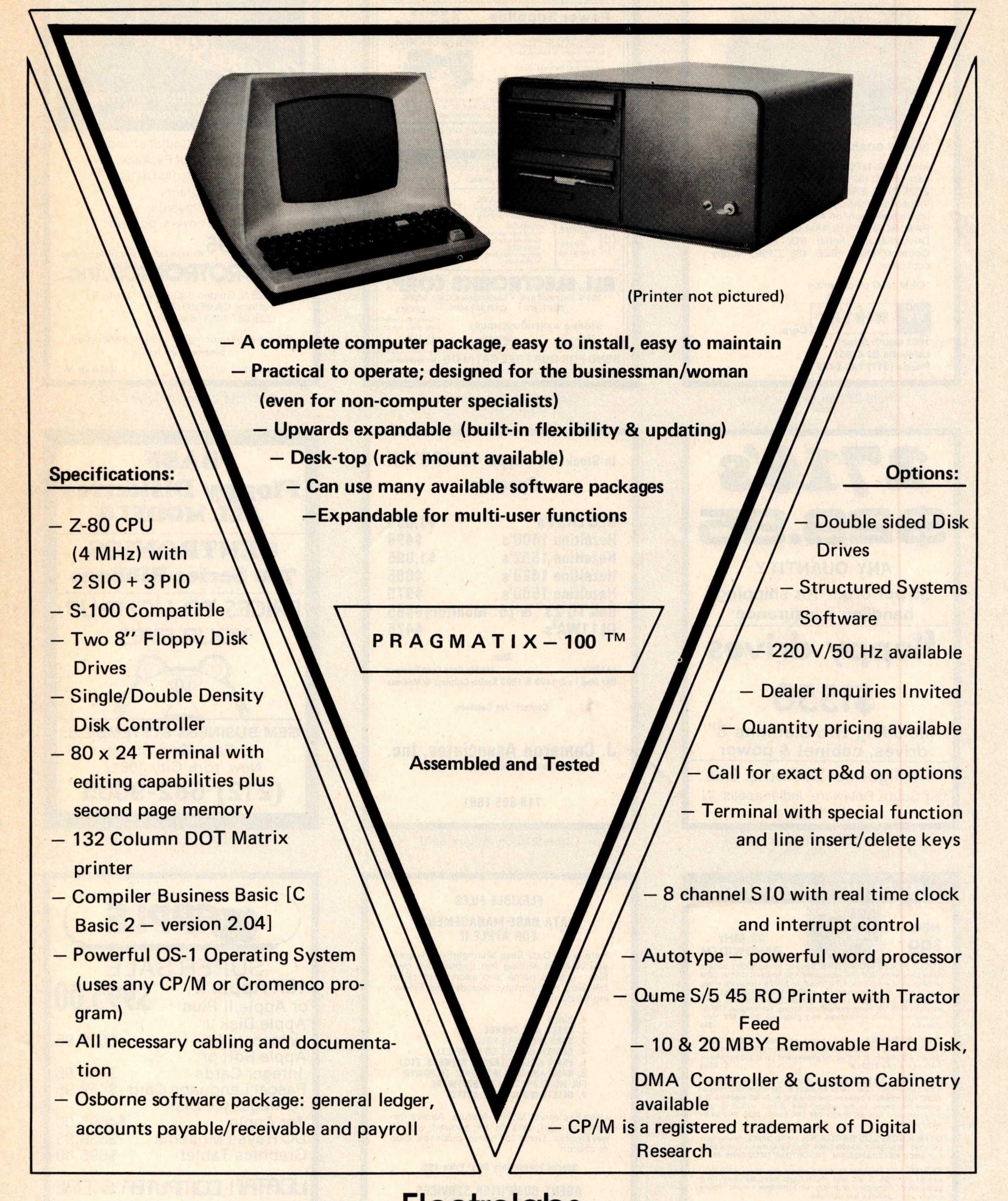
Full or Part Time

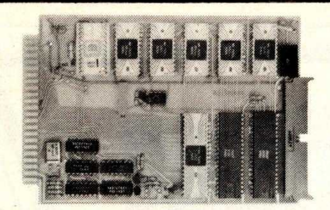
You will use your computer to input data from local accounts onto our Host Computer
- We pay $1500 to $2500 per month predicated on amount of data entered
- You must own or have access to a microprocessor or terminal
- You select hours & work load but you must consistently complete assignments
- You will be representing our company with Business & Professional people.

WRITE OR CALL FOR INFORMATION

NYLAC DATA SYSTEMS
P.O. Box 594
Warrensburg MO 64093
(816) 747-8011

Circle 234 on inquiry card.


PRAGMATIX-100
(Printer not pictured)
— A complete computer package, easy to install, easy to maintain
— Practical to operate; designed for the businessman/woman
(even for non-computer specialists)
— Upwards expandable (built-in flexibility & updating)
— Desk-top (rack mount available)
— Can use many available software packages
—Expandable for multi-user functions
Specifications:
— Z-80 CPU
(4 MHz) with
2 SIO + 3 PIO
— S-100 Compatible
— Two 8" Floppy Disk
Drives
— Single/Double Density
Disk Controller
— 80 x 24 Terminal with
editing capabilities plus
second page memory
— 132 Column DOT Matrix
printer
— Compiler Business Basic [C
Basic 2 — version 2.04]
— Powerful OS-1 Operating System
(uses any CP/M or Cromenco pro-
gram)
— All necessary cabling and documenta-
tion
— Osborne software package: general ledger,
accounts payable/receivable and payroll
PRAGMATIX — 100 ™
Assembled and Tested
Options:
— Double sided Disk
Drives
— Structured Systems
Software
— 220 V/50 Hz available
— Dealer Inquiries Invited
— Quantity pricing available
— Call for exact p&d on options
— Terminal with special function
and line insert/delete keys
— 8 channel S10 with real time clock
and interrupt control
— Autotype — powerful word processor
— Qume S/5 45 RO Printer with Tractor
Feed
— 10 & 20 MBY Removable Hard Disk,
DMA Controller & Custom Cabinetry
available
— CP/M is a registered trademark of Digital
Research



SINGLE BOARD COMPUTER $99.50*

with 6800 MPU, 6850 serial I/O, 2 6820 parallel I/O (32 lines), 512 RAM, socket for 2708, 2716, EROM. Interface modules for industrial control, data acquisition, lab instrumentation, on 44 pin 4½"x6½" PCB's. RAM, ROM, CMOS RAM/battery, A/D, D/A, Driver/Sensor, Serial I/O, Parallel I/O, Counter/Timer, IEEE 488 GPIB, floppy controller.

*OEM (500 piece) price



Corp.

1801 South Street
Lafayette, IN 47904
Phone (317) 742-8428

Circle 236 on inquiry card.



Circle 237 on inquiry card.



Circle 238 on inquiry card.

2716's
$29.95

ANY QUANTITY

$5 per order for shipping handling & insurance

floppy drives
$1550

including two Siemens 8" drives, cabinet & power

Intelligence Systems, Ltd.
124 South Delaware, Indianapolis, IN
(317) 631-5514

Circle 239 on inquiry card.

In Stock! Teletype 43 ASR's!!!

Specials:

DEC LA34's	$1,095
Hazeltine 1400's	$498
Hazeltine 1552's	$1,095
Hazeltine 1420's	$895
Hazeltine 1500's	$970
Ball TD 23" & 15" Monitors	$485
DL11WA's	$475

Also:

LA120's — Florida Data Corp Printers
Haz Mod I's & 1400 & 1500 Series Couplers & Modems

Contact: Joe Cameron

J. Cameron Associates, Inc.
One Grove St., Pittsford, NY 14534

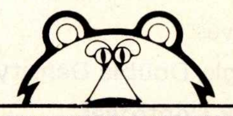
716-385-1681

Circle 240 on inquiry card.

BASF
Floppy Diskettes
ALL MODELS

CENTRONICS
700 Series Ribbons

PRICES TO LIGHT-UP YOUR EYES



GEM BUSINESS SYSTEMS Ltd.
60 East 42nd Street
New York City 10017
(212) 682-9005

Circle 241 on inquiry card.

SURPLUS INVENTORY

NEW $99



22 MHz BANDWIDTH

***SOLID STATE MONITORS:** Sylvania 12" B&W CRT, 22 MHz video bandwidth, 800 line resolution! ASL Model C12ACB. OEM tabletop style without case. P4 phosphor. Inputs = separate video, horz. & vert. pos. sync pulses at nominal TTL/CMOS levels. Any sweep rate, 10-20 KHz. 115 VAC. Simple TRS-80 hookup, add 2 jumpers. With full maint. manual incl. timing, schematics, TRS-80 hookup etc. Used, re-checked, very clean, no burns **$77**. New, checked, ... **$99**

2102 BONANZA: Prime, brand new static 1024x1 RAM. Fairchild F-2102-FPC, 350 ns. Sold in sleeves of 25. 1-3 sleeves at $20 ea, 4-9 sleeves at $16 ea. 10 sleeves and up at $10 per sleeve, that's prime, new 2102s at .... **$ .40 ea**

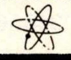
***S100 CORE SALE:** Brand new, tested Ampex core. See article "IT'S TIME FOR CORE" (9/79 Kilobaud p. 34) which describes an easily built interface between this core and an S-100 machine. But ignore the prices in the article! Sale priced, including large documentation pkg. 8K boards **$99** 16K boards **$230.** Add $4 for schematics of core.

***OTHER SURPLUS BARGAINS: HARD DISKS,** new w/manual $895. **SHUGART SA800-1/801** floppies w/manual, new $425. Full **ASCII KEYBOARDS** $44. **TOUCHTONE DECODERS $66.**

TERMS: UPS Included 48 states except disk drives. UPS COD add $1.25. VISA & MC add 4%. NJ add sales tax. Everything guaranteed. Immediate shipment or immediate refund. Phone orders and questions are welcome.

* **Write or call for full spec sheets on specific items.**

ELECTRAVALUE INDUSTRIAL
P.O. BOX 157-B
MORRIS PLAINS, NJ 07950



Phone orders are welcome.
201/267-1117

FLEXIBLE FILES

DATA BASE MANAGEMENT FOR APPLE II

Here is the Data Base Management System you've been waiting for! Define your own files — from name and address to client followup to inventory. Includes the following functions:

1. BUILD
2. CHECK AND CHANGE
3. SORT (MULTIPLE FIELDS)
4. SEARCH (SIMPLE OR COMPLEX)
5. PRINT (CREATE LABELS, REPORTS, ETC.)
6. NAME-ADDRESS INTERFACE TO POWERFUL WORD PROCESSING SOFTWARE.
7. DELETE (NO SPACE WASTED)

Uses Exclusive 'MENU' feature. Allows frequently used data to be entered with 2 keystrokes. Great for home, business, club or church.

Special Introductory Offer Price $95.

AGENT COMPUTER SERVICES
902 W. WAYNE ST.
FORT WAYNE, IN 46804
(219) 422-6551
48K-DISKII-APPLESOFT REQUIRED
DEALER INQUIRIES INVITED

Circle 243 on inquiry card.

APPLE

SUPER SALE

16K Apple II or Apple II Plus	$995.00
Apple Disk II w/controller	$529.95
Apple Soft or Integer Cards	$159.95
Pascal Language Card	$459.95
10 Megabyte Disk for Apple	$4695.00
DC Hayes Modems	$339.95
Graphics Tablet	$695.00

UCATAN COMPUTER STORE
P.O.BOX 1000 DESTIN, FL 32541
ACROSS FROM RAMADA INN
904-837-2022

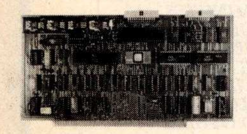
Credit Cards Accepted

Circle 244 on inquiry card.

DELTA IS READY . . .

Call For DEALER In Your Area

Z-80 CPU



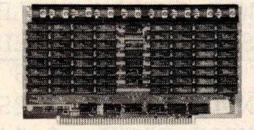
Two serial ports, three parallel ports. 2/4 MHz, on board Prom Monitor Phantoms. (Less cable and Monitor). A & T $325.00

DOUBLE/SINGLE DISK CONTROLLER



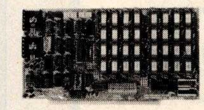
Two stage phase lock loop circuitry for greatest reliability, data transfer at maximum rate. Transparent density selection. 8" or 5" operation 2 or 4 MHZ (Some restrictions on DMA).
DMA — $425.00
STD. — $385.00

16K, 32K STATIC RAM



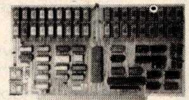
Worlds most reliable memory, responds to extended address lines A16, A17, cool running, fast.
16K-$395.00 32K-$650.00

32K, 48K, 64K DYNAMIC RAM



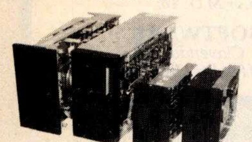
Basic dynamic board tested to run at 4MHZ with our Z-80 board. 4116 chips at 200 nanosecond speed insures most reliable data storage. Double density and DMA compatible.
32K-$580.00 48K-$640.00 64K-$750.00

32K, 48K, 64K ERROR DETECTING
Cromenco/ Alfa Micro



State of the art development. Parity generation and error detection. Compatible with 16 bit CPU designs. 16K bank, select under software control. 4MHZ Z-80, 8086, Cromenco, Alpha Micro compatible.
32K-$650.00 48K$725.00 64K-$850.00

FLOPPYS



8" Shugart $550.00
8" Siemans. $525.00
5" Siemans. $350.00
(Double Sided)
8" CDC. $675.00
8" Remex $645.00

TELEVIDEO 912



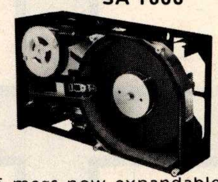
80 x 24—Lower case descenders. Teletype or typewriter keyboard 110/220 VAC. 50 to 19.2K Baud Hex entry pad. Similar to SOROC but better looking with NO FAN NOISE

TELEVIDEO 920



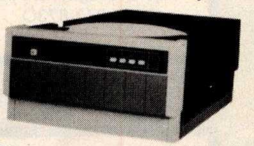
Similar to TV 912 but has programmable functions keys across top. Excellent for WORDSTAR Text Editing.

WINCHESTER/SHUGART SA 1000



5 megs now expandable to 10, works alongside floppy disk drive for expanded storage. Use with controller below.
$1950.00

WINCHESTER/CENTURY DATA SYSTEM
(Hunter Shown)



20 megs expandable to 40—Marksman series, plugs into our CPU parallel port or MP/M board drive, cabinet, power supply, 2.0 Bios.
$4850.00

FLOPPY DISKS

DYSAN Quality



8" SSSD $4.25
8" SSDD $5.50
8" DSDD $7.60
5" SSDD $4.10
(Boxes of 10 only)

MPM® I/O TIMER

Available March 1980

Designed for MP/M® software of Digital Research. 6 users serial port, three 8 bit parallel ports for hard disk. Timer and vectored interrupt.
®TM Digital Research

80 x 24 VIDEO



Keyboard input, Z—80 Processor, on board RAM makes this a non-memory mapped substitute for a terminal when mated with a keyboard.
$430.00

WINCHESTER/FLOPPY INTERFACE

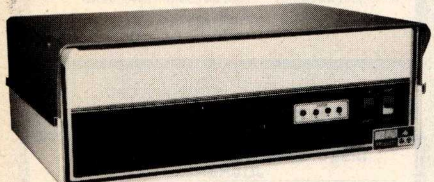
Available March 1980

Allows mixing of Shugart Winchester and floppy drives on same cable when used with DP-DSK. Supplied with software Bios for MP/M® and 2.0
®TM Digital Research

SOFTWARE/ CABLES/PROMS

CP/M® 2.2.	$150.00
MP/M®.	$350.00
2708 Monitor . . .	$ 25.00
2716 Monitor . . .	$ 40.00
Disk 50 Pin	$ 22.00
RS-232.	$ 15.00
CPU to Back. . . .	$ 32.00
Disk DC	$ 4.50
Disk AC	$ 2.50
Winchester.	$ 28.00

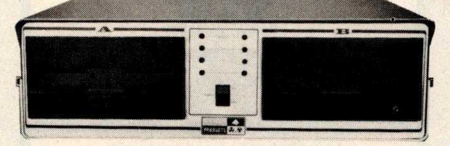
DP S-100 Main Frame



- 12 slot S-100 Motherboard (6 populated)
- +8V @ 20A ±16V @ 6A. (Nylon card guides).
- Mates with disk system shown in center column.
- 3 user convenience outlets at rear.
- Status indicators for I/O wait, memory error, voltage levels.
- Multi-user capable with circuit board selection at top.

Kit (less fans) $295.00 A & T $450.00

Disk Drive Storage



- Cabinet comes with multiple power.
- Supply to suit all popular disk drives ±5A, +24 @ 6A.
- DP-1000K Twin double density Shugart SA-800B or Siemens FDD-100-8 (1 megabyte). $1800.00
- DP-2000K Double sided, double density Shugart SA-850-R or Siemens FDD-200-8 (2 megabytes). $2450.00
- Drive box less drives with ample power supply.

Kit (less fans) $295.00 A & T $450.00

NORTH STAR Competitor



- Cost effective Z-80 dual drive micro system.
- Double density Siemans drives sport 340K single sided, 680K double sided.
- 32K RAM standard, expandable to 64K.
- CPM® 2.0 software included.

$2450.00

West:
DELTA PRODUCTS
15392 Assembly Lane, Unit A
Huntington Beach, Calif. 92649
Tel: (714) 898-1492

Circle 245 on inquiry card.



Telex: 681-367 DELTMAR HTBH

East:
DELTA PRODUCTS
11 Edison Drive
New Lennox, Illinois 60451
Tel: (815) 485-9072

MYCHESS

- Highest scoring microcomputer chess program at the 1979 ACM North America Computer Chess Championship.
- Available for CP/M, CDOS, IMDOS, TRS-80, hard-sectored North Star with CP/M
- Program allows 9 levels of play
- Searches on the opponent's time
- Program enables you to save game for later play
- Optional formated hard copy of game
- Allows computer to play itself

$50.00

Contact:

COMPUTER SERVICES
2431 Lyvona Lane
Anchorage, AK 99502
(907) 243-8730

Circle 246 on inquiry card.

MINI FLOPPY SALE

TRS-80 OWNERS
SINGLE SIDED $365.00
DOUBLE SIDED $485.00
READY TO GO-CABINET-
POWER SUPPLY-CABLE
ASSEMBLED & TESTED

ADD ON DRIVES
SINGLE SIDED $225.00
DOUBLE SIDED $ 345.00

INTERFACE, INC.
20932 CANTARA STREET
CANOGA PARK, CA. 91304
(213) 341-7914

MASTER CHARGE & VISA

Circle 247 on inquiry card.

TRS-80 II
TWO NEW CASSETTES

• VENTURE ANALYSIS •
ANALYSE VARIOUS EFFECTS IN MINUTES
7 YR RESULTS INCLUDE:
REVENUES, COSTS
BT & AT EARNINGS
UNDEPRECIATED CAPITAL
CASH FLOW — ROIC
AND OTHERS
16 K 14.95

• DUPL. BRIDGE SCORING •
4, 5, 6 TABLES
HOWELL MOVEMENT —
ENTER SCORES, BOARD AND PLAYER TOTALS
4K 6.95

Check or M.O. To:
RLK SOFTWARE
1310 E. Clavendon St.
Arlington Heights, IL 60004

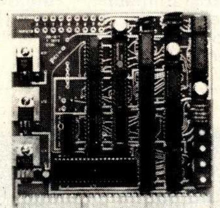
Circle 248 on inquiry card.

WE HAVE
8039
MICROCOMPUTERS

NEW PRIME PARTS
- TIMER APPLICATIONS
- CLOCKS
- SYSTEM CONTROLLERS
- KEYBOARD ENCODING
- 5 VOLT SUPPLY 6MHz
- ETC.

SEND CHECK FOR IMMEDIATE DELIVERY
1-5 $19 6-25 $15
OVER 25 CALL OR WRITE:
MARSHALL PHILLIPS
U.S.I., DEPT. 37
10324 S. DOLFIELD ROAD
OWINGS MILLS, MD 21117
(301) 363-3000 TELEX: 8-7675

AD-8/1 ANALOG I/O INTERFACE



FOR SS-50 BUSS 6800 SYSTEMS

- 8 A/D input channels
- Very fast A/D over 8500 samples per second
- 1 D/A output channel with sample and hold
- Bipolar input and output
- Full 8 bit resolution
- Upward compatible to 680X
- Complete documentation
- Fully assembled and tested
- Visa and M.C. accepted

$109.50

CCM, INC.
P.O.Box 2308
Reston, VA 22091

Circle 250 on inquiry card.

MICRO MART

16K UPGRADE KIT FOR TRS-80, APPLE, PET, SORCERER $70
Mostek 4215-3 200ns 16K x 1 RAMS

MICROPOLIS 8" HARD DISK DRIVE with Power, S-100 controller
9 Megabyte $3995
27 Megabyte $4495
45 Megabyte $4995

TI 994 $1050.00

DISCOUNTS on EXIDY SORCERER, PET, most other systems, peripherals, and software.

MICROCOMPUTERS, PERIPHERALS AND SOFTWARE
1015 NAVARRO SAN ANTONIO, TEXAS 78205
512/222-1427

Circle 251 on inquiry card.

NOW *Fastest Data Manager* PET™

JINSAM™

- CUSTOM DATA FILES
- CUSTOM REPORTS/LABELS
- FAST/EASY/MENU DRIVEN
- KEYED RANDOM ACCESS
- MULTIPLE SEARCH KEYS
- PRIVACY ACCESS CODES
- WILD CARD SEARCH

Specify CBM 2040 or COMPU/THINK DISK
Package $150 **USERS GUIDE ONLY $25**
Demo Tape $5 Disk $8

Check or Money Order plus $2 Shipping
(NY residents add 8% Sales Tax)
– DEALER INQUIRIES WELCOMED –

JINI MICRO-SYSTEMS, Inc.
P.O. Box 274-B • Bronx, NY 10463

Circle 252 on inquiry card.

BUSINESS SOFTWARE
CP/M AND MODEL II COMPATIBLE
NEWLY ENHANCED VERSIONS

MEDICAL MGMT SYSTEMS $495
DENTAL MGMT SYSTEM $495
REAL ESTATE MULTI-LIST $495
INSURANCE AGENCY MGMT $495
LEGAL TIME ACCOUNTING $495
GENERAL LEDGER $495
ACCOUNTS PAYABLE $495
ACCOUNTS RECEIVABLE $495
PAYROLL PROCESSING $495
INVENTORY MANAGEMENT $495
WORD PROCESSING/NAD $495
DATABASE MANAGEMENT $495
HIGH-SPEED UTILITY SORT $300

NEW! LATEST CBASIC-2 .... $ 99
NEW! LATEST MBASIC 5.1 .... $300
NEW! MBASIC COMPILER $350

**CP/M 2.0 FOR MODEL II $170
COMPLETE SOFTWARE CATALOG 5
COMPLETE HARDWARE GUIDE 5

UNIVAIR, INC. 314-426-1099
10327 LAMBERT INTL AIRPORT
ST. LOUIS, MISSOURI 63145 USA
MASTER CHARGE/VISA CARDS O.K.

Circle 253 on inquiry card.

DISBURSEMENTS & CASH RECEIPTS JOURNALS

In stock & ready to go to work, ready to ship....no waiting

a.) Co-authored, debugged and used by a licensed, practicing CPA.
b.) A copyrighted document balance routine provides for no-fault entries.
c.) As many as 4 Gen. Ledger postings for each document, can all be different.
d.) Document types supported by programs:
DJ-1001 Cash/Checks/Payroll
CJ-2001 Deposits/R.O.A/Credit Memo
e.) Complete audit trails for analysis.
f.) Concise, ready-to-use printouts.
g.) No special training. Programs use live-cueing at every step.
h.) Fully Documented, with listings, & supplied on 5¼" diskette, written in TRS-80 Basic.
i.) Also available in MOD II format.
j.) Total support-for 1-year from date-of-purchase.

DISBURSEMENTS JOURNAL DJ-1001 $75.00
CASH RECEIPTS JOURNAL CJ-2001 $75.00
SPECIAL..BOTH PROGRAMS ONLY $120.00

Complete software packages, and computer supplies at competitive prices.

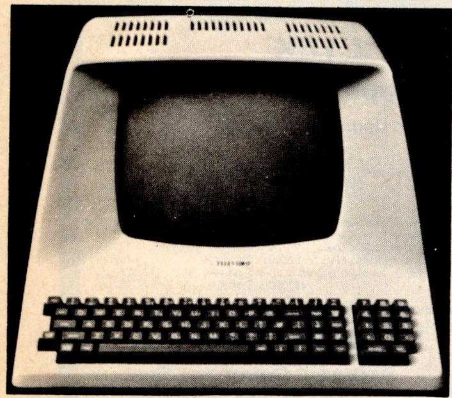
Checks O.K. **S & A DATA SYSTEMS**
Master Charge/Visa P O BOX 39
NO COD's Craig, CO 81625

NO CHARGE 1-800-854-2003 (ext 804) TOLL
In Calif. 1-800-522-1500 (ext 804) FREE

Circle 254 on inquiry card.

Try to beat our prices!

TELEVIDEO TVI-912



Upper case and lower case; 15 baud rates: 75 to 19,000 baud; dual intensity; 24 x 80-char. display, 12 x 10 resolution. Numeric pad. Programmable reversible video; aux. port; self-test mode; protect mode; block mode; tabbing; addressable cursor. Microprocessor controlled; programmable underline; line and character insert/delete.

OUR PRICE ONLY $789

OTHER VIDEO TERMINALS

INTERTUBE II, List $995 . . . ONLY $799
PERKIN-ELMER 550, List $997 . . . . $799
with anti-glare screen, $1027 . . . . . $829
HAZELTINE 1400, List $850 . . . . . $699
1410, List $900 . . . . $749
1420 . . . . $849
1500, List $1225 . . . . $989
1500 Kit, List $1125 . . . . $799
1510, List $1395 . . . . $1089
1520, List $1650 . . . . $1389
ADDS R-20, List $995 . . . . $945
R-100, List $1325 . . . . $1295
LEAR SIEGLER ADM3A Kit $775
ADM3A Assembled $849
ADM31, List $1450 . . . . $1295
ADM42, List $1795 . . . . $1595
SOROC 120, List $995 . . . . $795
IQ140, List $1495 . . . . $1249

PRINTERS

ANADEX 80-col. dot matrix, $995 . . $895
INTEGRAL DATA IP-125 NOW ONLY $689
IP-125 w/1210 option, $838 . . NOW $724
IP-225 w/1210 & 1250 op., List $988 $834
IP-225 w/tractor, 1210, 1250, 1221
(2K Buffer), 1241 (graphics) NOW $899
IDS-440 Paper Tiger, List $995 . . . . . $895
w/graphics op., incl. buffer, $1194 . $1069

CENTRONICS
730-1 parallel interface, List $995 . . . $849
779-1, Friction Feed, List $1245 949
779-2 w/Tractor, List $1350 1049
702-2 w/Tractor, VFU, List $2480 . . 1995
703-2 w/Tractor, VFU, List $2975 . . 2395

NORTH STAR HORIZON

NOW DOUBLE & QUAD DENSITY

Complete w/12 edge connectors, 2 SIOs, 1 PIO, and extra drive cable. Assem. & Tested.

HORIZON 1 –
32K, DD, List $2695 . . . . $2279
32K, QD, List $2995 . . . . $2539

HORIZON 2 –
32K, DD, List $3095 . . . . $2619
32K, QD, List $3595 . . . . $3049
48K, DD, List $3590 . . . . $3039
48K, QD, List $4090 . . . . $3469
64K, DD, List $3830 . . . . $3239
64K, QD, List $4330 . . . . $3669

FLOPPY DISK SYSTEMS

MORROW THINKER TOYS® Discus 2D
List $1149 . . . . OUR PRICE $979
Discus 2D, dual-drive, List $1948 $1658
Discus 2+2, A&T, List $1549 . . . . $1319
Dual Discus 2+2, A&T, List $2748 . $2335
MICROMATION Megabox, double-density w/ 8" drives, 1-megabyte, List $2295 . $1949
2-megabyte, List $3095 . . . . $2629
MICROPOLIS 1041 MacroFloppy® in enclosure (power source & regulator board required), List $695 . . . . $625
1042 MacroFloppy w/case & AC P.S. . $709
1053 Dual MetaFloppy®, List $1895 . $1695

VIDEO BOARDS

SD COMPUTER VDB-8024 Video
Display Bd, I/O mapped, kit $370 . . $299
Assembled, List $470 . . . . $399
VECTOR GRAPHICS Flashwriter®
FW-64 memory mapped, A&T, $270 $229
FW-80u/lc 80-char. line, A&T, $368 . $313
XITEX SCT-100K, Kit . . . ONLY $154.95
SCT-100A Assembled $174.95
SSM VB1B Memory Mapped Video
Interface, 16x64, Kit, List $155 . . . $132
Assembled & Tested, List $210 . . . . $178
SSM VB2 I/O Mapped Video Interface
Kit, List $169 . . . . $144
Assembled & Tested, List $234 . . . . $199
INTER SYSTEMS (formerly Ithaca Audio)
Memory Mapped Video Board, 16x64
Assembled & Tested, List $165 . . . . $149

CONVERT YOUR SELECTRIC TO A COMPUTER PRINTER!

Power supply & electronics, A&T. You make only a simple solenoid installation (or have the factory do it). Manufactured by ESCON.

S-100 Interface Version, List $496 . $445
Universal Types:
Parallel – (Centronics format, for TRS-80, Sorcerer, Apple, etc.) List $525 . . . $469
IEEE-488 (for PET), List $560 . . . $499
RS232 Standard Serial, List $549 . $489
TRS 80 Cable $27

CPU BOARDS

NORTH STAR Z80A Processor Board
A&T (ZPB-A/A), List $299 . . . . . . $254
CROMEMCO 4MHz CPU Card
A&T (ZPU-W), List $395 . . . . $335
CROMEMCO 4 MHz Single Card Computer
A&T, List $450 . . . . $382
VECTOR GRAPHIC Z-80 CPU Board
A&T, List $247 . . . . $210
ITHACA AUDIO Z-80 CPU Board, 4 MHz
A&T, List $205 . . . . $179
2 MHz, A&T, List $175 . . . . $155
DELTA Z-80 CPU with I/O, A&T . . . $239
SD Single Card Computer (SBC-100)
Kit, List $295 . . . . $250
A&T, List $350 . . . . $298

MEMORY BOARDS

NORTH STAR 16K Dynamic RAM Board,
A&T (RAM-16-A/A), List $499 . . . $420
32K A&T (RAM-32/A), List $739 . . $620
CROMEMCO RAM Card w/bank select, A&T
16K (16KZ-W), List $595 . . . . $495
64K (64KZ-W), List $1795 . . . . . $1485
MEASUREMENT SYSTEMS & CONTROLS
Guaranteed performance, incl. labor/parts 1 yr
DM6400 64K Board w/all 64K, $795 $659
DM4800 with 48K, List $695 . . . $589
DM3200 with 32K, List $595 . . . $509
DM1600 with 16K, List $495 . . . $429
DM0000 with no RAM, $395 . . . . $349
THE DMB SERIES –
DMB6400 64K Board w/all 64K . . $859
DMB4800 with 48K $789
DMB3200 with 32K $709
MORROW SuperRAM, A&T
16K Static Board, 4 MHz or
2 MHz, List $349 . . . . $299
32K Static Board, 4 MHz, List $699 . $629
VECTOR GRAPHIC, 8K Static, A&T . $239
48K Dynamic Board, List $799 . . . $679
SD ExpandoRAM w/o RAMS, List $220 $187
INTER SYSTEMS (formerly Ithaca Audio)
8K Static 250ns, A&T, List $195 . . $176

FLOPPY DISK CONTROLLER BOARDS

MORROW Disk Jockey 1, A&T ($213) . $189
Disk Jockey 2D, A&T, List $479 . . . $429
SD Versafloppy I, A&T, List $335 . . . $233
Versafloppy II, DD Kit, List $430 . . $360
Versafloppy II, DD, A&T, List $350 . $278
DELTA double density A&T ($385) . $345
CONDUCTOR, double density A&T . . $269
ITHACA AUDIO, A&T, List $175 . . . $155
MICROMATION Doubler, double density
Controller Board, A&T, List $495 $399
TARBELL Floppy Disk Interface, Kit . $169
double density, Kit, List $325 . . . . $295
double density, A&T, List $425 . . . $380

SHIPPING, HANDLING & INSURANCE – Add $2 for boards, $5 for Selectric converter, $7.50 for Floppy Disk Systems, $15 for Horizons. Shipped freight collect: Cromemco Systems, Centronics, DEC, NEC, and T.I. printers. Contact us for shipping information on other terminals and printers.

All prices subject to change and all offers subject to withdrawal without notice. Prices in this ad are for prepaid orders. Slightly higher prices prevail for other-than-prepaid orders, i.e., C.O.D., credit card, etc.

—WRITE FOR FREE CATALOG —

MiniMicroMart, Inc.



1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 255 on inquiry card.

ADVANCED COMPUTER PRODUCTS

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.89
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.29	SN74160N	.95
SN7429N	.45	SN74161N	.95
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.29	SN74164N	.97
SN7438N	.29	SN74165N	.97
SN7439N	.29	SN74166N	1.20
SN7440N	.24	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.57	SN74172N	5.95
SN7443N	.79	SN74173N	.79
SN7444N	.79	SN74174N	.89
SN7445N	.79	SN74175N	.89
SN7446N	.79	SN74176N	.85
SN7447N	.59	SN74177N	.85
SN7448N	.79	SN74179N	1.80
SN7450N	.23	SN74180N	.75
SN7451N	.23	SN74181N	1.75
SN7453N	.23	SN74182N	.75
SN7454N	.23	SN74184N	1.95
SN7459N	.29	SN74185N	1.95
SN7460N	.23	SN74186N	9.95
SN7470N	.39	SN74188N	3.90
SN7472N	.34	SN74190N	1.15
SN7473N	.38	SN74191N	1.15
SN7474N	.36	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.36	SN74194N	.85
SN7479N	4.60	SN74195N	.85
SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.55	SN74199N	1.39
SN7485N	.65	SN74221N	1.39
SN7486N	.39	SN74251N	.95
SN7489N	1.75	SN74273N	1.05
SN7490N	.39	SN74279N	.89
SN7491N	.65	SN74283N	2.15
SN7492N	.52	SN74284N	3.90
SN7493N	.49	SN74285N	3.90
SN7494N	.72	SN74290N	1.25
SN7495N	.65	SN74298N	.95
SN7496N	.72	SN74365N	.68
SN7497N	3.10	SN74366N	.68
SN74100N	.99	SN74367N	.79
SN74107N	.32	SN74368N	.79
SN74109N	.53	SN74390N	1.90
SN74116N	1.95	SN74393N	1.90
SN74121N	.29	SN74490N	1.90
SN74122N	.39		

CMOS

CD4000	.29	CD4093	.99
CD4001	.29	CD4094	2.95
CD4002	.29	CD4098	2.49
CD4006	1.39	CD4099	2.25
CD4007	.29	MC14408	12.95
CD4008	1.39	MC14409	12.95
CD4009	.59	MC14410	12.95
CD4010	.59	MC14412	12.95
CD4011	.29	MC14415	8.95
CD4012	.29	MC14419	4.95
CD4013	.49	CD4501	.39
CD4014	1.39	CD4502	1.65
CD4015	1.39	CD4503	.69
CD4016	.59	CD4505	8.95
CD4017	1.19	CD4506	.75
CD4018	1.19	CD4507	.95
CD4019	.49	CD4508	3.95
CD4020	1.19	CD4510	1.39
CD4021	1.49	CD4511	1.39
CD4022	1.29	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.79	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.79	CD4520	1.39
CD4028	.99	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.69	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	1.19	74C08	.49
CD4037	1.95	74C10	.49
CD4040	1.29	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.99	74C30	.39
CD4043	.99	74C32	.99
CD4044	.99	74C42	1.85
CD4046	2.25	74C48	2.39
CD4047	1.25	74C73	.99
CD4048	.69	74C74	.99
CD4049	.69	74C85	2.49
CD4050	.69	74C89	4.95
CD4051	1.10	74C90	1.85
CD4052	1.10	74C93	1.85
CD4053	1.10	74C95	1.85
CD4055	3.95	74C107	1.19
CD4056	2.95	74C151	2.49
CD4059	9.95	74C154	3.50
CD4060	1.39	74C157	2.10
CD4066	.89	74C160	2.39
CD4069	.35	74CC161	2.30
CD4070	.69	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.59
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
CD4076	1.29	74C192	2.39
CD4077	.35	74C193	2.39
CD4078	.35	74C195	2.39
CD4081	.35	74C922	7.95
CD4082	.35	74C923	6.95
CD4085	1.95	MM80C95	1.50
CD4089	2.95	MM80C97	1.25

74LS00

74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.89
74LS05N	.28	74LS170N	1.99
74LS08N	.39	74LS173N	.89
74LS09N	.39	74LS174N	.99
74LS10N	.28	74LS175N	.99
74LS11N	.39	74LS181N	2.20
74LS12N	.39	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	1.25	74LS192N	.98
74LS15N	.39	74LS193N	.98
74LS20N	.26	74LS194N	1.15
74LS21N	.38	74LS195N	.95
74LS22N	.38	74LS196N	.89
74LS26N	.39	74LS197N	.89
74LS27N	.39	74LS221N	1.49
74LS28N	.39	74LS240N	2.99
74LS30N	.26	74LS241N	2.49
74LS32N	.39	74LS242N	2.29
74LS37N	.79	74LS243N	2.29
74LS38N	.39	74LS244N	2.95
74LS40N	.26	74LS245N	8.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.79	74LS249N	1.69
74LS51N	.26	74LS251N	1.79
74LS54N	.35	74LS253N	.98
74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.59	74LS259N	2.95
74LS75N	.68	74LS260N	.69
74LS76N	.45	74LS261N	2.49
74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
74LS90N	.75	74LS283N	1.10
74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.95
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.29
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.65
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.99
74LS126N	.89	74LS368N	.99
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.69
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
74LS157N	.99	74LS668N	1.75
74LS158N	.75	74LS670N	2.29
74LS160N	.98	81LS95N	1.99
74LS161N	1.15	81LS96N	1.99
74LS162N	.98	81LS97N	1.99
74LS163N	.98	81LS98N	1.99

LINEAR

78H05	5.95	LM1414N	1.90
78M06	1.49	LM1458CN/N	.49
78M.G.	1.49	MC1488N	1.49
LM105H	.99	MC1489N	1.49
LM108AH	2.95	LM1496N	.89
LM300H	.79	LM1556N	1.50
LM301CN/H	.35	LM1800N	.79
LM304H	.98	LM1820N	.95
LM305H	.89	LM1850N	.95
LM306H	3.25	LM1889N	3.95
LM307CN/H	.29	LM2111N	1.75
LM308CN/H	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25	LM2917N	2.95
LM311D/CN/H	.98	CA3013T	2.29
LM312H	1.75	CA3018T	1.99
LM317T	2.75	CA3021T	3.49
LM318CN/H	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.49	CA3039T	1.49
LM320T-XX*	1.25	CA3046T	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.25
LM324N	1.25	CA3060N	3.25
LM339N	.95	CA3062N	4.95
LM340K-XX*	1.49	LM3065N	1.49
LM340T-XX*	1.25	CA3080N	1.29
LM340H-XX*	1.25	CA3081N	1.69
LM344H	1.95	CA3082N	1.69
LM348N	1.85	CA3083N	1.99
LM358CN	.98	CA3086N	1.29
LM360N	1.49	CA3089N	2.75
LM372N	1.95	CA3096N	2.49
LM377N	3.75	CA3097N	1.99
LM377N	3.75	CA3130T	2.49
LM380CN/N	1.25	CA3140T	2.49
LM381N	1.79	CA3146N	2.49
LM383T	1.95	CA3160T	1.49
LM386N	1.49	CA3190N	1.95
LM387N	1.49	CA3401N	.69
LM390N	1.95	MC3423N	1.49
NE531V/T	3.75	MC3460N	3.95
NE555V	.39	SQ3524N	3.95
NE556N	.98	CA3600N	3.50
NE561T	7.95	LM3900N	.59
NE562B	7.95	LM3905N	1.49
NE565N/H	1.25	LM3909N	.98
NE566H/V	1.75	RC4131N	2.95
NE567V/H	1.50	RC4136N	1.10
NE592N	2.75	RC4151N	4.50
LM702H	2.99	RC4194	4.95
LM709N/H	.29	RC4195	4.40
LM710N/H	.98	ULN2001	1.25
LM711N/H	.39	ULN2003	1.50
LM715N	1.95	SN75450N	.59
LM723N/H	.75	SN75451N	.49
LM733N/H	.98	SN75452N	.49
LM739N	1.15	SN75453N	.49
LM741CN/H	.33	SN75454N	.49
LM741CN-14	.19	SN75491N	.89
LM747N/H	.79	SN75492N	.89
LM748N/H	.39	SN75493N	.89
LM760CN	2.95	SN75494N	.89
LM1310N	1.90		

FLOPPY DISK DRIVES

MPI B51-5¼", 40 tracks	279.00
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	475.00
Siemens Shugart Compatible Model 120-BD	429.00
PERSCI Model 277 Dual	1195.00
WANGO/SIEMENS 5¼" Drive	290.00
MPI B52 5¼" Dual	395.00
WANGO/SIEMENS 282 Dual 5¼"	395.00
WANGO/SIEMENS 82	290.00

HICKOK LX303 $69.95





.5%, 3½ digit 19 Range DVM, ½" LCD displays runs 200 hrs on 1 battery. 10 Meg Ohm Input. 1 yr. guarantee, made in U.S.A., test leads included.

Available Accessories

RC-3 115V AC Adapter	$7.50
CC-3 Deluxe Padded Vinyl Carrying Case	$7.50
VP-10 X10 DCV Probe Adapter/ Protector 10 Kv	$14.95
VP-40 40 Kv DC Probe	$35.00
CS-1 10 Amp Current Shunt	$14.95

TEXAS INSTRUMENTS INCORPORATED

Calculator Discount Prices

TI 30 SP	17.95
TI 50	39.95
TI 55	35.95
TI 57	54.95
TI 58C	97.95
TI 59	219.95
TI PC 100C	146.95
TI 1035	15.95
TI 1750	19.95
TI 5025	69.95
TI 5040	79.95
TI Data Card	26.95
TI Data Chron	37.95
TI Business Analyst II	42.95
TI Programmer	48.95
TI MBA	57.95
TI Business Card NEW	34.95
TI Speak & Spell	64.95
TI Dataman	19.95
TI Spelling B	27.95
TI Li'l Professor	12.95
TI Vowel Power	12.95
TI Super Stumpers 4, 5, 6	12.95
TI Super Stumpers 7, 8	12.95

MONITORS

Sanyo 9"	$169.95
Sanyo 15"	279.00
Leedex 12"	139.95
Motorola 12", High Resolution, 22 MHz, OEM Model #M3000-340	219.00
Zenith 13" Color	499.00
MGA 13" Color TV	349.00

TRS-80/APPLE

MEMORY EXPANSION KITS
4116's
16K (200/250 ns.)
8 pcs. for **$62.95**
w/instructions & jumpers.
Call For Volume Pricing

HAZELTINE TERMINALS

Model 1400	$775.00	Model 1500	$1085.00
Model 1410	$825.00	Model 1510	$1245.00
Model 1420	$945.00	Model 1520	$1495.00

Continental Specialties

Model 3001 Digital Capacitance Meter	275.00
Model 333 Tri-Mode Comparator	295.00
Model LM-3 40-channel Logic Monitor	585.00
Model LM-1 Logic Monitor	60.00
Model LM-2 Logic Monitor	147.00
Model 2001 Sweepable Function Generator	186.00
Model 5001 Universal Counter-Timer	360.00
Model 6001 650 MHz Frequency Counter	385.00
MAX-100 100 MHz Portable Frequency Counter	149.00
PS-500 500 MHz Decade Prescaler	70.00
MAX-50 50 MHz Handheld Frequency Counter	77.00
MAX-550 550 MHz Handheld Frequency Counter	165.00
Model 4001 Pulse Generator	835.00
Model DP-1 Digital Pulser	83.00
Logic Probes	
Model LP-1 Digital Logic Probe	50.00
Model LP-2 Economy Logic Probe	28.00
Model LP-3 High Speed Logic Probe	77.00
Model LPK-1 Logic Probe Kit	21.95
Logic Probe Accessories	21
Model LTC-1, LTC-2 Logical Analysis Kits	220/250

Apple II. 16K or Apple II. Plus $990

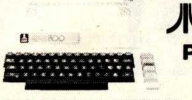


16K Apple Upgrade Kit $62.95

Hi-Speed Serial I/O	$174.95	DS65 Digi-Sector	$349.00	Integer ROM Card	$175.00
Centronics Printer I/O	199.95	Apple Graphics Tablet	795.00	Proto Card	21.95
Applesoft II Firmware	174.95	D.C. Hayes Modem II	349.95	M & R Modulator	29.95
Apple Clock	189.95	Disk II w/Controller	475.00	Sanyo Cassette	54.95
Introl X-10 System	269.95	Disk II	575.00	16K Upgrade Kit	62.95
Introl X-10 Controller	179.95	Pascal Lang. System	475.00	Apple Radio Car	159.00
Alf Music Synthesizer	259.95	Parallel Printer Card	165.00	8" Floppy Controller	350.00
16 Ch. Analog Input	249.95	Communications Card	210.00	Heuristics Speechlab	179.00
2 Ch. Analog Output	164.95	Business Software Pkg.	625.00	Romplus +	169.00
13-Key Keypad	119.95	Corvus 10 Megabyte Drive	4625.00	Supertalker	279.00
Visi-Calc	149.95			Cashier	250.00

ATARI® 800 & 400

Personal Computer System

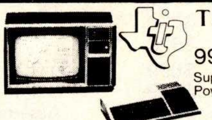


ATARI 800 $899.00
ATARI 400 $499.00

ATARI 800 Includes: Computer Console, BASIC Lang. Cartridge, Education System Master Cartridge, BASIC Language Programming Manual, 800 Operator's Manual w/Notebook, Atari 410 Program Recorder, 8K RAM Module, Power Supply, TV Switch Box.

Peripherals		**Education System Cassette Programs**		Spelling	35.00
Disc Drive	599.00	U.S. History	35.00	Basic Electricity	35.00
Printer	499.00	U.S. Government	35.00	Basic Algebra	35.00
Program Recorder	69.00	Supervisory Skills	35.00	**Basic Game and Program Cassettes**	
Software – ROM Cartridges		World History (Western)	35.00	Guide to BASIC Programming	18.00
Education System Master Cartridge	28.00	Basic Sociology	35.00	BASIC Game Programs	19.00
Atari BASIC	55.00	Counseling Procedures	35.00	**Add-On Memory**	
Assembler Debug	55.00	Principles of Accounting	35.00	8K RAM Memory Module	110.00
Basketball	42.00	Physics	35.00	16K RAM Memory Module	225.00
Life	42.00	Great Classics (English)	35.00	**Diskettes**	
Super Breakout™	42.00	Business Communications	35.00	Blank Diskettes	
Music Composer	55.00	Basic Psychology	35.00	Disk File Manager	5.00
Super Bug™	42.00	Effective Writing	35.00	**Accessory Controllers**	
Computer Chess	55.00	Auto Mechanics	35.00	Driving Controller Pair	18.00
Home Finance	55.00	Principles of Economics	35.00	Paddle Controller Pair	18.00
				Joystick Controller Pair	18.00

TEXAS INSTRUMENTS INCORPORATED



99/4 PERSONAL COMPUTER

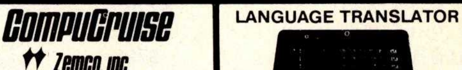
Superior Color, Music, Sound and Graphics – and a Powerful Extended Basic – All Built In.

$1099.00

commodore PET AS LOW AS $775.00



2110-8K	775.00	2022 80-Col Dot Matrix Printer	995.00
2001-16KN	975.00	2023 80-Col Plain Paper Printer	849.00
2001-16KB (reg)	975.00	2040 Dual Mini Disk Drive	1250.00
2001-32KN	1250.00	Pet to IEEE Cable	39.95
2001-32KB (reg)	1250.00	IEEE to IEEE Cable	49.95
2021 80-Col. Printer	549.00	C2N External Cassette Deck	95.00
2022 80-Col Dot Marix Printer	995.00		



CompuCruise

Zemco, Inc.

Model 44 with cruise control $174.95

Model 41 without cruise control $154.95

An onboard navigational computer for automobiles, trucks, and recreational vehicles. Features cruise control, fuel management system, trip computer, multifunctioned quartz crystal time counter, plus many other functions.

LANGUAGE TRANSLATOR

CRAIG M-100 188.95

23.95

Phonetics: Spanish, French, German, Italian, Japanese.

- A Personal Interpreter When You Travel.
- A Valuable Learning Aid When You Study.
- A Spelling and Phonetic Pronunciation Guide.
- A Calculator and Metric Converter.
- Stores Approximately 5,000 Words and Phrases.
- References Three Languages At Once.

HAND HELD COMPUTER SPORTS GAMES

$18.95 EA.



Hand Held While Supply Lasts

ELECTRONIC FOOTBALL **ELECTRONIC SOCCER**

BSR System X • 10

Control Lights and Household Appliances, Protect your family with fingertip convenience.

Starter Kit **79.95**
Includes command console, appliance module and two large modules.

Ultrasonic Command Module with Cordless controller **59.95**



Lamp, wall switch and appliance modules.
14.95 ea.

SINGLE BOARD COMPUTER SELECTION GUIDE

BOARD	PROCESSOR	ACP PRICE	ENCLOSURE
KIM-1	6502	169.00	Add 29.95
SYM-1	6502	249.00	Add 39.95
Cromemco	Z80	409.00	N/A
SD-SBC100	Z80	239.00	N/A
AIM 65	6502	375.00	Add 49.95
Cosmac Vip	1802	249.00	Inc.

RETAIL STORES OPEN MON-SAT

STORE #1 1310 "B" E. Edinger, Santa Ana, CA 92705 — Showrooms, Retail, Warehouse

STORE #2 674 El Camino Real, Tustin, CA 92680 — Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230

FOR INTERNATIONAL ORDERS:
1401 S. Borchard (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

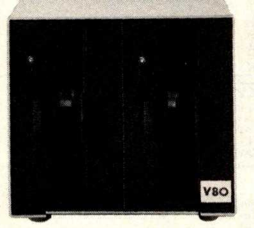
Circle 256 on inquiry card.

The Supermarket for TRS-80* Add-on Components (and other computers, too)

In stock now. Immediate delivery.

The VISTA V-80 Disk Drive System

- 23%more storage capacity than TRS-80
- 120 day warranty
- 40 track patch at NO CHARGE





Single drive system	$ 395.00
Two drive system	$ 770.00
Four drive system	$1450.00
Two drive cable	$ 29.95
Four drive cable	$ 39.95

The VISTA V-80 Expansion Module

- Provides double density modification to your current Radio Shack interface (lets you format diskettes in either single or double density).
- Increases storage capacity up to 204K bytes (on single 40 track drive).
- Includes all hardware and software.

$239.00



The VISTA Model II

- Provides one, two or three drives.
- Adds up to 1.5 million bytes of on-line storage.
- 120 day warranty
- Does everything Radio Shack's expansion system will do...for less!

$1000.00	Single drive Expansion System
$1550.00	Two drive Expansion System
$2100.00	Three drive Expansion System
$ 525.00	Additional drives alone

The TRS-80 Printers

Centronics 730... **$945.00**
7x7 dot matrix-
80 column

Anadex
DP8000... **$895.00**
9x7 dot matrix-
80 column

VISTA
Printer... **$745.00**
5x7 dot matrix-
80 column

Cables .... **$27.50 each**

Other Products

1. VISTA Verbatim diskettes (hard or soft sector) Certified 40 track .... $ 38.95
2. 16K RPM upgrade kits, guaranteed for 120 days. **PRIME PRODUCT** .... $ 74.50
3. NEW! DOS + ... $ 110.00
4. LNW expansion bare board .... $ 66.95
5. H.C. Pennington book, **TRS-80 Disk and Other Mysteries** .... $ 18.95
6. DDT Disco-Tech disk drive timer .... $ 19.95
7. Cryptext (An Encryption Module) $299.00

Add On Drives

MPI B51	40 Track, Double Density-204K	$275.00
MPI B52	Dual Head, Double Density-408K	$375.00
Siemens	FDD100-5 40 Track Double Density 204K	$275.00
Siemens	FDD100-5 Flippy, records both sides	$290.00
Siemens	FDD100-8 8" Single Sided Drive	$448.00

The VISTA V-200 for Exidy

- Completely packaged system, tested and ready to plug in, includes: power supply, two 40 track drives, case, controller, all cabling and total CPM documentation.
- Storage capacity from 400K to 1.2 meg.
- System software-VISTA CP/M Disk Operating System and BASIC-E Compiler recorded on 5-1/4" diskettes.

Price: Starting as low as **$1199.00**



CALL TOLL-FREE 800-854-8017

*TRS-80 is a registered trademark of Radio Shack.

The Vista Computer Company 1401 Borchard Street • Santa Ana, California 92705 • 714/953-0523

Circle 257 on inquiry card.

Unclassified Ads

UNCLASSIFIED POLICY: *Readers who are soliciting or giving advice, or who have equipment to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name and address information.*

These notices are free of charge and will be printed one time only on a space available basis. Notices can be accepted from individuals or bona fide computer users clubs only. We can engage in no correspondence on these and your confirmation of placement is appearance in an issue of BYTE.

Please note that it may take three or four months for an ad to appear in the magazine.

FOR SALE: SOL-20 with 32 K programmable memory, dual North Star disk drives with power supply, and cabinets. Completely operational. With North Star disk operating system, BASIC, and many disks full of programs. $2700. Clifford C Anthony, (301) 863-8468.

FOR SALE: B & K oscilloscope Model #1471, 15 MHz bandwidth; $500. Optical paper-tape reader; $25. Richie, (305) 553-4326 after 5 PM.

FOR SALE: Percom disk SwTPC compatible controller board with cable, MDOS-PLUS operating system in programmable read-only memory (no booting), plus TSC Edit and Text Processor with Touchup, Microsoft G2-Standard BASIC, Microware ABASIC compiler, and all disk utility programs on two minifloppies. All hardware $200 firm; software free with purchase. Just add Percom disk drive for $375 for complete disk system. M B Scudiere, 100 Ceder Ln, Oak Ridge TN 37830, (615) 482-1355.

FOR SALE: Save $500 on iCOM disk controller for one to four disk drives. IBM 3740 compatible. Use with Shugart, Siemens, Pertec,. . .floppy-disk drives. With manual containing S-100 and 6800 interface instructions. Just checked out by factory. Cost $850, only $250. Okidata 110 cps commercial quality printer with full options including pressure and tractor feed and self-test. Like new, just rebuilt by factory. With RS-232 interface, only $850. PT factory assembled S-100 bus 8 K programmable memory, $85. H H Hayden, POB 1275, Socorro NM 87801.

FOR SALE: KIM-1 microcomputer including all documentation, $100. Electronic Systems 32 by 32-character video board, $75. Cyclic redundancy check ASCII (uppercase) keyboard, $25. All postpaid. Kerch Holt, 115 High St, Bath ME 04530, (207) 443-3588.

FOR SALE: Two 8 K static programmable-memory boards by Base 2 and IMS respectively. One music board by Newtech. All for $325. Assembled and manuals included. Call after 6 PM. James Chen, (213) 363-4593.

FOR SALE: I have two Rockwell AIM-65 microcomputers to sell. They are in their original cartons unopened. The 1 K is being offered for $325 and the 4 K for $425. I will ship these units UPS and will pay postage. Alfred F Stahler, 5521 Big Oak Dr, San Jose CA 95129, (408) 252-4219.

FOR SALE: IMSAI MIO board with modifications to make it work, two parallel ports, serial port, Tarbell cassette port, software drivers, serial port untested. Two IMSAI 4 K programmable-memory boards, one Godbout 8 K Econoram board, 62-key ASCII keyboard in dress enclosure. Make offer on any or all. Roy Turner, 14407 Broadgreen, Houston TX 77079, (713) 497-5849.

FOR SALE: Fairchild/Veras (44-pin bus) Micro System boards. One processor, one mother board, and two 4 K static memory boards. All expertly assembled, tested, and socketed. Much documentation, hardware, software, assembly manuals, and 4 K BASIC included. First $200 takes all or best offer. Also, OAE OP-80 paper-tape reader (solid-state) 0 thru 5000 cps. Interfaces to any 8-bit parallel port. Assembled and working. Supplied with full documentation. $55. Paul Ramos, 100 Middle St, Woburn MA 01801, (617) 935-3758.

WANTED: Development system for Intel 8048 and/or 8080 microprocessors. Prefer Model 230 Intellec Series II, but will consider any model. Also interested in any extras (ie: ICE, or what have you). Reed Hannebaum, 6821 Birdie Ln, St Louis MO 63129.

FOR SALE: One IMSAI 32 K programmable-memory board, $500. Never used, but was working at 2 MHz when bought. Quitting microcomputing. J Phillips, 3435 N 75th Dr, Phoenix AZ 85033.

FOR SALE: BYTE magazines, March 1977 thru September 1978. Make me an offer. Dick Neish, 904 Marday, Sioux Falls SD 57103.

FOR SALE: North Star computer. Piecemeal or package. Memory, processor, single-density drive. D Montano, 13 Macfarlan St, Hawthorne NJ 07506.

FOR SALE: Expanded KIM system: two 8 K programmable-memory boards, 2 K erasable-programmable read-only memory S-100 mother board, separate 64 by 16 television typewriter, fast tape input/output (I/O), books, much software; all for $400. Fred Monsour, 309 Camellia Dr, Charlottesville VA 22903, (804) 977-8077.

FOR SALE: BYTE, November 1976 thru December 1978, twenty-six issues, $25. *Interface Age*, February 1977 thru December 1978, twenty-two issues, $21. *Kilobaud*, June 1978 thru December 1978, seven issues, $6. Or all for $50 FOB. R Mendelson, 27 Somerset Pl, Murray Hill NJ 07974, (201) 464-5244.

FOR SALE: PET computer, 8 K programmable memory, includes five prerecorded tapes, all in perfect working condition. $650. Stan Prokop, 4330-B 2nd Ave, Ft Knox KY 40121, (502) 624-8650.

FOR SALE: Intel SDK-85 SBC system, completely assembled with extra 8155 wired in, instruction book, assembly manual, MCS-85 users manual. See article in January 1979 BYTE, page 60. Asking $260, you pay shipping. Sam Stickle, 651 E Travis Blvd #14, Fairfield CA 94533, (707) 422-4850.

FOR SALE: Quitting hobby. All test equipment, integrated circuits, transistors, capacitors, resistors, etc must go. Send SASE for list and prices. Steve Pang, 99-709 Hoio St, Aiea HI 96701.

FOR SALE: E and L MMD-1 8080A Mini/Micro computer with one MI interface board. An excellent tutorial system. 2.5 K programmable memory, monitor and D-Bug in programmable read-only memory, octal keyboard entry, tape cassette interface, and serial input/output (I/O) for teletype or monitor. A-1 condition. $395. Don Woods, 12012 Pebblebrook Ln, Carmel IN 46032, (317) 846-8388.

FOR SALE: Factory assembled ELF-II in almost new condition. Includes power supply, user manuals, light pen, speaker interface, and other information. Worth about $170, sell for $150. Tom Court, 8745 Greenway Ave S, Cottage Grove MN 55016, (612) 459-4340.

FOR SALE: PolyMorphic 88 system: 8080 processor, 24 K programmable memory, 300 bps and 1200 bps cassette interface with Superscope recorder, serial printer interface board, Javelin video monitor, and keyboard. Excellent condition, runs great. Includes hardware/software manuals, BASIC, Assembler, and Disassembler programs. $1500 or best offer. J Comer, 221 Reynolds Rd, Raleigh NC 27609, (919) 781-3072.

FOR SALE: Teletypes: ASR33 ($450), KSR33 ($375), KSR35 ($550); high-speed teletype line printer ($285), high-speed paper punch ($135), INVAC paper punch ($60). Will consider trade for memory, video, or other S-100 boards. Shipping extra, call for condition. Jim, (509) 547-8745 evenings.

GENEALOGY: I am using a microcomputer to help bring order out of chaos in my collected documentation of several thousand ancestors. I would like to be able to store, file, sort, retrieve, and cross-reference genealogical data. I would also like to be able to have pedigree, individual, and family group printouts, as well as indexes. I would like to hear from others having a similar interest (it also has relevance to tracing genetic disorders and there are other analogs), so that a network of information could be pooled and shared. Clifton M Howard, 5[illegible] Orden Rd, Harrington Park NJ 07640.

PROGRAM EXCHANGE: The Craig County Public Schools have placed Level II TRS-80s in pilot programs in elementary and secondary schools. These machines are being used with computer-assisted instruction (CAI) programs and educational programs. Because of an apparent scarcity of CAI programs, K-12, school personnel and advanced secondary students are developing such programs. This process is quite slow, however, when the ultimate objective is to offer CAI in a variety of subjects at all grade levels. We would be glad to contact schools and/or individuals interested in exchanging programs which they have developed. Earl R Savage, Craig County Public Schools, POB 245, New Castle VA 24127.

FOR SALE: PolyMorphic Systems Poly 88 computer system including: 8080A processor board, 16 K memory board, video interface board (memory-mapped with graphics), mainframe with input/output (I/O) amp power supply, keyboard, modified TV, cassette interface, and all documentation. BASIC, Assembler software on tape. 1.5 years old. $1100 or best offer. Joel Cardon, 4 University Hill Way, Logan UT 84321, (801) 752-5516 after 7 PM.

FOR SALE: AIM-65 microcomputer with built-in printer, full ASCII keyboard, and 20-character alphanumeric display. Interfaces to two audio cassette recorders and 20 mA loop teletypewriter. Unit includes $75 4 K programmable memory option and $85 Assembler read-only memory option. Original price of complete system purchased 6/79 was $535. Asking $450. Bob Findley, 5 Marvin Pl, Bethel CT 06801, (203) 792-9945.

WANTED: NOVA Assembler Manual, DGC 093-000017 and/or Assembler punched tape program for NOVA. R A May, 306 Ferguson Ave, Elizabethton TN 37643.

FOR SALE: L/S ADM 31 video display. N/S Horizon processor, 32 K programmable memory, two double-density disks. T/I Omni 810 printer. P Mundy, 49 E 12 St #3F, New York NY 10003.

FOR SALE: Diablo series 30, 2.5 megabytes disk drives, compatible with many processor interfaces: Texas Instruments, Interdata, Data General, DEC, etc. $995 for drive. $110 for power supply which will power two disk drives. Jon Shechter, 556 Rutherford Dr, Seaford NY 11783, (516) 796-8683.

Ciarcia Wins Three in a Row

Steve Ciarcia has won the BOMB for the third consecutive month. He will receive a $100 check for his January article, "Computerize a Home." Our congratulations go to Steve for an excellent job. Second place was a tie between John Gibson and Edward Joyce for their respective articles, "A Computer-Controlled Light Dimmer, Part I: Design," and "Telephone Dialing by Computer." Ken Skier's article on "Indirect Addressing for the 6502" placed third.

The first place article was 2 standard deviations above the mean, and the two second place articles placed 0.8 standard deviations above the mean. ■

Reader Service

*To get further information on the products advertised in BYTE, fill out the reader service card with your name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 15-cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE. *Correspond directly with company.*

BOMB BYTE's Ongoing Monitor Box

Article #	Page	Article	Author
1	18	**Using the Computer as a Musician's Amanuensis, Part 1: Fundamental Problems**	**Raskin**
2	34	**Add a Simple Text Editor to Your BASIC Program**	**Goff**
3	40	**Ease Into 16-Bit Computing, Part 2: Examining a Small Multi-User System**	**Ciarcia**
4	70	**Advanced Real-Time Music Synthesis Techniques**	**Chamberlin**
5	96	**Computing the *I Ching* with a TRS-80**	**Dethlefsen**
6	118	**Calculating Filter Capacitor Values for Computer Power Supplies**	**Thomas**
7	124	**A Graphics Text Editor for Music, Part 1: Structure of the Editor**	**Nelson**
8	142	**The Great Race and Micro Disk Files, Horse Race Simulations**	**Roehrig**
9	198	**Program Those 2708s!**	**Glaser**
10	212	**Apple Audio Processing**	**Cross**
11	234	**Build a Low-Cost EPROM Eraser**	**Golter**

Bomb results on previous page





Get the most out of your microcomputer with Graham-Dorian Business software.

At any given time, your hardware is only as useful as the software you insert in it.

So it pays to rely on Graham-Dorian, the software that gets your micro performing to its fullest — almost like a mini.

Graham-Dorian, the industry leader, offers highly detailed and well-documented programs. All pretested on the job. Each so comprehensive that it takes little time to learn to run a program — even for someone who's never operated a computer before.

Programs are compatible with most major computers using CP/M disk operating systems, and come in standard 8″ or on various mini-floppy disks. Each package contains the software program in INT and BAS file form plus a user's manual and hard copy source listing. Graham-Dorian stands behind dealers with technical advice when needed.

Yes, there's a world of difference in business software. Count on Graham-Dorian for more per-package capabilities and more packages. (With new ones added every few months.)

Professional Packages

- Medical
- Dental
- Surveying
- Apartment Management
- Construction Job Costing

General Accounting Packages

- Accounts Receivable
- Accounts Payable
- General Ledger
- Inventory
- Payroll
- Cash Register

CBASIC-2

(All accounting packages are interactive, with a single entry updating all affected files.)

Ask your dealer for a demonstration soon.



Graham-Dorian Software Systems, Inc.
211 North Broadway / Wichita, KS 67202 / (316) 265-8633

Circle 259 on inquiry card.



C8P DF $2,597

Ohio Scientific's top of the line personal computer, the C8P DF. This system incorporates the most advanced technology now available in standard configurations and add-on options. The C8P DF has full capabilities as a personal computer, a small business computer, a home monitoring security system and an advanced process controller.

Personal Computer Features

The C8P DF features ultra-fast program execution. The standard model is twice as fast as other personal computers such as the Apple II and PET. The computer system is available with a GT option which nearly doubles the speed again, making it comparable to high end mini-computer systems. High speed execution makes elaborate video animation possible as well as other I/O functions which until now, have not been possible. The C8P DF features Ohio Scientific's 32 x 64 character display with graphics and gaming elements for an effective resolution of 256 x 512 points and up to 16 colors. Other features for personal use include a programmable tone generator from 200 to 20KHz and an 8 bit companding digital to analog converter for music and voice output, 2-8 axis joystick interfaces, and 2-10 key pad interfaces. Hundreds of personal applications, games and educational software packages are currently available for use with the C8P DF.

Business Applications

The C8P DF utilizes full size 8″ floppy disks and is compatible with Ohio Scientific's advanced small business operating system, OS-65U and two types of information management systems, OS-MDMS and OS-DMS. The computer system comes standard with a high-speed printer interface and a modem interface. It features a full 53-key ASCII keyboard as well as 2048 character display with upper and lower case for business and word processing applications.

Home Control

The C8P DF has the most advanced home monitoring and control capabilities ever offered in a computer system. It incorporates a real time clock and a unique FOREGROUND/BACKGROUND operating system which allows the computer to function with normal BASIC programs at the same time it is monitoring external devices. The C8P DF comes standard with an AC remote control interface which allows it to control a wide range of AC appliances and lights remotely without wiring and an interface for home security systems which monitors fire, intrusion, car theft, water levels and freezer temperature, all without messy wiring. In addition, the C8P DF can accept Ohio Scientific's Votrax voice I/O board and/or Ohio Scientific's new universal telephone interface (UTI). The telephone interface connects the computer to any touch-tone or rotary dial telephone line. The computer system is able to answer calls, initiate calls and communicate via touch-tone signals, voice output or 300 baud modem signals. It can accept and decode touch-tone signals, 300 baud modem signals and record incoming voice messages. These features collectively give the C8P DF capabilities to monitor and control home functions with almost human-like capabilities.

Process Controller

The C8P DF incorporates a real time clock, FOREGROUND/BACKGROUND operation and 16 parallel I/O lines. Additionally a universal accessory BUS connector is accessible at the back of the computer to plug in additional 48 lines of parallel I/O and/or a complete analog signal I/O board with A/D and D/A and multiplexers.

Clearly, the C8P DF beats all existing small computers in conventional specifications plus it has capabilities far beyond any other computer system on the market today.

C8P DF is an 8-slot mainframe class computer with 32K static RAM, dual 8″ floppies, and several open slots for expansion.

C8P $895

Or get started with a C8P with cassette interface, 8K BASIC-in-ROM which includes most of the features of the C8P DF except the real time clock, 16 parallel I/O lines, home security interface and accessory BUS. It comes with 8K static RAM and Ohio Scientific's ultra-fast 8K BASIC-in-ROM. It can be expanded to a C8P DF later. Base price $895. Virtually all the programs available on disk are also available for the C8P cassette system on audio cassette.

Computers come with keyboards and floppies where specified. Other equipment shown is optional.

For literature and the name of your local dealer, CALL 1-800-321-6850 TOLL FREE.

OHIO SCIENTIFIC
1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • (216) 831-5600

marcus 6

Circle 260 on inquiry card.